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STUDIES IN THE DYNAMICS OF BEHAVIOR

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AND

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INTRODUCTION

For an understanding of the social behavior of the individual a knowledge of the sources and nature of the motives which determine conduct is of fundamental importance. Our educational facilities have been mobilized chiefly to provide for the intellectual training of those who have the interest and will to learn, and techniques for the development and control of social attitudes lag far behind those for technical or intellectual training. The gifted youth who says, "I would rather be known as one who could, if he would, than succeed in anything," is a far more difficult problem and a more questionable social asset than the less-gifted plodder. It is far easier to teach the habitual delinquent the fundamentals of arithmetic than conformity to the accepted social code. As yet, there are scarcely any recognized methods for developing the social attitudes which contribute to make the individual a useful member of society. We muddle along with precept and example, pretty successfully as a rule, but are often hopelessly at a loss to deal with the exceptional child for whom the traditional procedures have been ineffective.

We do not know the real differences between the ambitious and the slothful, the dreamer and the go-getter, the honest and dishonest, the selfish and generous, the leader and follower, in spite of many dogmatic statements in the psychological literature. One group, differing in other respects as widely as the behaviorists and the psychoanalysts, would have us believe that temperamental differences are wholly the result of childhood training and that uniform education beginning at birth would result in a uniform product. Other equally influential groups have minimized the environmental factors and have ascribed unlike temperaments to different hereditary endowments. The more conservative have asserted the existence of constitutional differences but assumed their ready modification under social pressures; the more radical have regarded the constitutional differences as inalterable and expressed a pessimistic attitude toward all efforts at social control.

Not less in dispute than the origin of temperamental differences is their significance as dynamic forces in behavior. One group of extremists, including many students of psychopathology, has ascribed all human motivation to emotional pressure, making emotion the most potent force in behavior. Others, at the opposite extreme, deny any functional value to emotion, regarding it only as an explosive discharge of energy occurring when the individual is unable to make an adaptive response. For some, human motives are products of mental energy; for others, tensions in the muscles of the viscera; and no more striking evidence of the need for critical research in the field could be desired than the conflict of opinion revealed at the recent Wittenberg symposium on emotion.

Field studies and experiments in social control, although offering valuable suggestions as to the importance of various factors in determining social attitudes, are not calculated to give crucial evidence upon the origin, nature, and stability of motives, because the situations encountered are so complex and the contributing factors so numerous as to defy analysis even by the most refined statistical means. There is a greater hope for a solution of some of the fundamental problems in controlled laboratory studies, although these can, as yet, deal only with a few isolated phenomena and, at best, must be followed by long investigations of means for applying their results to social situations.

The major problems of motivation which may be approached by experimental studies fall into four groups: the origin of temperamental differences, their nature as biological phenomena, their stability in comparison with other types of behavior, and their significance for social adaptation. From the standpoint of social control, the immediate interest is in the two latter questions—stability and effectiveness as motivating agents; but the decisive answer to these may well come from the more remote approach through the first two questions. The studies reported in the following pages must be judged, to some extent, as an adventure in methodology. The problems of motivation are not yet clearly defined, and much pioneer work is still to be done. The devising and evaluating of methods of study is now of far greater scientific value than the accumulation of masses of indecisive data. Although the present studies deal with diverse aspects of the problem, by different methods and with different material, they have in common a biological point of view and the utilization of careful experimental controls.

Dr. Stone has attacked the problem of the genetic origin of temperamental differences and the possibility of their modification by training. It is almost impossible to obtain conclusive evidence concerning heredity with human material because of the lack of adequate records of earlier generations, nor can we identify heritable traits of behavior in man with any confidence. It is therefore necessary to turn to experimentation with animals for at least a tentative answer. The demonstration of different heritable traits, clearly suggestive of temperamental differences in man, and the measurement of their modifiability in the individual by training marks an important step toward the solution of the problem of the origin and stability of temperamental differences.

The work of physiologists showing the functional importance of bodily changes in emotion and the evidence for constitutional types advanced by Kretschmer, Jaensch, and others justifies the search for physiological characters which may correlate with temperamental differences. Dr. Darrow and Miss Heath present a detailed study of changes in the electrical resistance of the body with evidence of a relationship between certain characters of the electrical response and temperamental traits of the subjects. The significance of the electrical changes themselves is not altogether clear, but they are probably the best available indexes of the activity of the vegetative nervous system. Hence their correlation with definite traits of character is significant as evidence that the latter are dependent upon fundamental organic conditions.

The demonstration of a genetic origin and organic basis of temperamental differences would still leave open the question of their importance for any given type of social adjustment. In the third study Dr. Landis raises the question of whether the emotional constitution, as indicated by the available questionnaire and laboratory tests, can be regarded as a generally significant factor among the great number of conditions which contribute to delinquency.

In the fall of 1927 the Social Science Research Council made available to the Behavior Research Fund and the Institute for Juvenile Research a grant for the study of emotional factors which might be contributory to delinquency in children. The papers included in this volume are a part of a wider program, including clinical and sociological studies, which have been carried out with the assistance of the grant. I take pleasure in acknowledging, on behalf of the Fund, Institute, and the individual investigators, the aid and co-operation so generously given by the Social Science Research Council.

K. S. LASHLEY

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WILDNESS AND SAVAGENESS IN RATS OF DIFFERENT STRAINS

By CALVIN P. STONE

INTRODUCTION[1]

Wildness and savageness in rats are commonly called "native" expressions of emotional behavior. As such they are of special interest to students of genetic psychology because it is believed that their study will shed some light upon the biological nature of emotional responses in man. In studies of wildness and savageness, however, as in other studies of the emotions, acceptable experimental situations are difficult to standardize and indexes are seldom unequivocal. Hence, one should be prepared to expect that many pioneer studies of these traits must be made before any but the most tentative conclusions may be reached concerning their hereditary foundations, humoral dependency, relationship to other modes of behavior in experimental situations, etc.

---

[1] This study was made under the auspices of the Behavior Research Fund during sabbatical leave from Stanford University. I am deeply indebted to Dr. Herman Adler for the opportunity of initiating this problem, and to Dr. K. S. Lashley for guiding suggestions as to the selection and conduct of phases of the problem which seemed feasible to undertake during the one year at my disposal.

PREVIOUS STUDIES

For a general account of the life-history of the wild brown rat (*Mus norvegicus*) no better references can be given than those of Lantz (1909, 1910), Miller (1911), and Donaldson (1924).

In Miller's study one finds interesting observations on the reproductive processes of the brown rat, which processes in the albino and piebald rat have more recently received detailed consideration at the hands of many experimenters. Miller notes that in the brown rat there is nothing closely resembling courtship between the sexes; that females are less pugnacious when in the receptive phase of the oestrus cycle than at other times; that vicious fighting is not restricted to males but also is prevalent among females or animals opposite in sex. Size is said to be an important factor in determining social domination and colony control. For instance, a large, rutting female may at one moment chase a small male about the cage but in the next submit to copulation with a male larger than herself. He found that captured wild females ate about half of their litters, and that this carnivorous tendency was not corrected by increasing either the amount of meat or the grain in the daily ration. Other items of a more purely biological interest will not be cited because of their irrelevancy for the present topic.

Yerkes (1913) has published a preliminary report of what is probably the first systematic study of the heredity of savageness, wildness, and timidity in rats. Using a five-point rating scale he attempted to measure differences in these traits among wild rats, tame rats, and hybrids of the first and second generations. Wild rats which had spent their developmental period in the free state were taken as types meriting the highest values on the scale; the lower values were given to animals derived from a tame colony which for many generations had been maintained in the laboratory. The activities indicating savageness were as follows: (1)

biting; (2) exposing or gnashing the teeth; (3) jumping at hand or forceps; and (4) squeaking. Wildness was indicated by (1) attempts to hide from view in the cage or the hand; (2) random and excited running about in the cage or excited attempts to escape from the hand or the forceps; (3) squeaking; (4) urination and defecation. Timidity was displayed by (1) attempts to avoid the experimenter; (2) a kind of chattering or gnashing of the teeth; (3) cowering and what looks like trembling; (4) urination and defecation. As will be observed, no clear-cut behavior units differentiate timidity from wildness; hence, as Yerkes says (1913) (p. 287), "It is indeed extremely doubtful whether it can with sufficient certainty be distinguished from wildness to render measurements significant."

The F_1 generation of hybrids was obtained by crossing wild males with tame, hooded females, and the F_2 generation came from promiscuous crossing of the F_1 hybrids. Two strains of tame hooded animals were at hand and were used in the original matings. One had a wide and the other a narrow stripe down the back. The former was known to have somewhat more wild blood than the latter; hence their offspring were given separate treatment in the consideration of results. Tests were begun when the young had attained the ages of about 6 weeks, and were completed within the first or second month thereafter. Each animal was tested, as a rule, from three to five times. From the first to the last test, a very considerable drop in the values received by the animals of each group was noted, and attributed either to the influence of handling in the experiments, the taming influence of cage restraint, or, possibly, to aging.

Yerkes did not report tabular data for the full-blood wilds or the tame, hooded animals used as the parent stock; but inasmuch as they represented the opposite ends of his rating scale, it may be assumed, from what is known of trapped and colony rats, that there was little overlapping between their ratings. In presenting the results for the F_1 and F_2 generations, Yerkes gave only the means and the frequency tables of ratings; hence, without further calculations one cannot test the significance of group differences reported. The latter tests are desirable in order to determine whether conclusions based upon differences of means alone are warranted.[1]

Working with the data given in his frequency tables, it was possible for us to compute the reliability of differences between the means of all groups discussed by Yerkes, and thus to test the significance of difference toward which his comments and conclusions are directed. Our computations will be reported for the traits of savageness and wildness only, for as we have already noted, timidity could not be clearly separated from wildness in the original ratings. The means for the average ratings (which Yerkes considers most suitable indexes of the traits in question) correspond in each case to those reported by Yerkes (1913) in Tables 3, 4, 5, 6, and 7.

TABLE 1

SUMMARY OF RESULTS FOR FIRST-GENERATION HYBRIDS, F_1 (NARROW × WILD), AND SECOND-GENERATION HYBRIDS, F_2 (NARROW × WILD)

Based on average ratings for savageness and wildness as given in Yerkes' Tables 3 and 4, pp. 292–93.

Item	Trait	Groups*	Difference of Means	$\frac{D}{P.E._{diff}}$
1	Savageness	†Male F_1 vs. Female F_1	0.70	3.83
2	Wildness	†Male F_1 vs. Female F_1	0.54	3.82
3	Savageness	Male F_2 vs. Female F_2	0.26	1.40
4	Wildness	Male F_2 vs. Female F_2	0.27	1.87
5	Savageness	Male F_1 vs. Male F_2	1.52	6.93
6	Wildness	Male F_1 vs. Male F_2	1.36	7.08
7	Savageness	Female F_1 vs. Female F_2	2.57	15.07
8	Wildness	Female F_1 vs. Female F_2	2.01	15.69

e of the first-named gr

Concerning the first-generation hybrids derived from the tame, narrow stripes by wild, Yerkes states that, "without exception, the females grade higher than the males." Items 1 and 2 of Table 1 show that the difference between means is probably reliable and that the conclusion should stand as given. With respect to the second generation, derived from the F_1 hybrids, he says that "a comparison of the results for the two sexes indicates a marked difference in that, whereas the F_1 females grade higher than the males, the F_2 males grade higher than the females." Items 3 and 4, Table 1, show that the differences between means for these groups are small and very unreliable. As for the F_1 and F_2 generations, he notes that average ratings of the F_1 exceed those of the F_2 generation. As indicated by items 5–8, the differences between means for these groups are highly significant and the conclusion warranted.

---

[1] Seldom did an author writing in comparative psychology as early as 1913, the date of this publication, provide sufficient data to enable a later worker to apply statistical methods for the evaluation of small differences. This is one of the many commendable features of Yerkes' excellent study.

TABLE 2

s for First-Generation Hybrids, F_1 (Wide×Wild), $_2$ (Wide×Wild)

Based o rating savagene eans as given in Yerkes' Tables 5 and 6, pp. 204-95.

Item	Trait	Groups*	Difference of Means	$\frac{D}{\text{P.E.}_{\text{diff.}}}$
1	Savageness	Male F_1 vs. Female F_1	0.11	0.36
2	Wildness	Male F_1 vs. Female F_1	0.11	0.23
3	Savageness	†Male F_2 vs. Female F_2	0.45	1.34
4	Wildness	Male F_2 vs. Female F_2	0.05	0.09
5	Savageness	Male F_1 vs. Male F_2	1.20	2.48
6	Wildness	Male F_1 vs. Male F_2	0.43	1.37
7	Savageness	Female F_1 vs. Female F_2	0.68	1.20
8	Wildness	Female F_1 vs. Female F_2	0.37	0.92

* The mean of the first named group is larger than the second except where marked by a dagger (†)

With respect to the hybrids derived from the wide-striped tame-wild parentage, Yerkes finds no noteworthy sex differences. His observations are confirmed by the data of lines 1–4 of Table 2. He states that "the second generation of wide by wild individuals grades nearly as high as the first generation and is thus in marked contrast with the second generation of the narrow by wild rats." Also, he says that "this apparently indicates that savageness, wildness, and timidity are of lower grade development in the second generation than in the first generation of wide by wild individuals." Lines 5–9 show that differences in the relevant means are very small, and that, although those of the F_1 group are actually higher than those of the F_2 generation, the differences are unreliable. Thus the foregoing conclusion, based on the means alone, is very weak if not unwarranted.

The wide-striped females were known to have more wild blood in them than the narrow-striped females. From this it might be expected that the ratings of the hybrids derived from the wide-striped females would be the higher. On this point Yerkes says that the differences of the means "indicate clearly the influence of the wild blood in the wide tame parent." This point we have subjected to test by considering the reliability of differences. Lines 1 4 of Table 3 indicate very small and wholly unreliable

1	Savageness	Male F_1 W vs. Male F_1 N	
2	Wildness	Male F_1 W vs. Male F_1 N	
3	Savageness	Female F_1 W vs. Female F_1 N	
4	Wildness	Female F_1 W vs. Female F_1 N	
		Wide F_2	
	Savageness	Male F_2 W vs. Male F_2 N	[illegible]
	Wildness	Male F_2 W vs. Male F_2 N	[illegible]
	Savageness	Female F_2 W vs. Female F_2 N	[illegible]
	Wildness	Female F_2 W vs. Female F_2 N	[illegible]

* The mean of the first-o roup is larger than the second except where marked by

differences between the means of the F_1 generations of hybrids derived from the narrow and the wide females. As for the F_2 generations, differences are much larger and in each case are significant. Practically speaking, no difference exists between the F_1 narrow and the F_2 wide, but relatively large and reliable differences are found between the F_2 wide and the F_2 narrow. Were it not for the fact that rating scores of the F_2 generation of narrow hybrids dropped so markedly from those of the F_1 stock of narrow hybrids, there would be no reliable indication that the influence of the wild blood in the wide females was manifested in the behavior of the hybrids. So far as we can see, there is no substantial reason from the standpoint of animal genetics for expecting such a drop in the F_1 generation. A likely supposition is that it was brought about by some extraneous, non-hereditary factor associated with the rating scheme or with the handling of this group of animals. Such a drop was not obtained in the case of the second generation of the wide-striped hybrids, which, we believe, is as it should be. Of special interest in this connection is the fact that Coburn (1922), in his parallel study of the wildness and savageness of mice, did not find that a slightly greater percentage of wildness in the parent stock could be detected in the behavior of their offspring.

A point of special interest not brought out by Yerkes is the larger rating values consistently given to the trait of wildness as opposed to that of savageness.

Hammett (1921) has made some interesting observations on the relative susceptibility of wild and tame rats to loss of the parathyroid secretion. In his first experiments two groups of albinos were operated. One was composed of the ordinary albino stock of the Wistar Institute which had not been handled or otherwise tamed. The other was a group of the same kind of animals which had been made very gentle by handling from infancy. The former showed the usual signs of cowering, tension, and savageness; whereas the latter were not easily frightened and in all respects presented a picture of calmness and placidity. Complete thyroidectomy, which includes removal of the parathyroids, was done on 90 rats from the untamed stock. Of these, 79 per cent died in parathyroid tetany within 48 hours. During the same time, 87 per cent of the tame rats similarly treated survived. To test whether the results obtained were due to the loss of the thyroid secretion, a second series of experiments was performed in which the parathyroids alone were removed. In this series, the percentage of losses was almost identical with that of the foregoing experiment. Hammett suggests that thoroughgoing taming probably induced a condition of stability in the nervous system which afforded marked resistance to the loss of the parathyroid secretion. In a subsequent experiment performed upon wild Norway rats, the mortality was 90 per cent, as contrasted with 79 per cent in the untamed albino rats. This higher mortality is correlated with the greater wildness, savageness, and neuro-muscular activity of the full-blood wild rats. It is assumed that the higher neuro-muscular activity augments toxin formation and that death results because of the absence of the internal secretion from the parathyroid glands. So far as the reviewer knows, there has been no confirmation or refutation of the foregoing facts or hypotheses given to account for them.

In a genetic analysis of temperament, Sadovnikova-Koltzova (1926) reports that one may observe two types of temperamental variations in different strains of rats: the phenotypical variations, which change under the taming influences of the environment, and the genotypical variations, which persist despite this modifying influence. In this connection the following excerpts are of interest:

> Adult wild rats when caught, generally speaking, are not apt for training, and usually perish when confined in a cage; but young wild rats, although they differ very sharply from those born in captivity, can be more or less trained and bring forth progeny in captivity after mating with laboratory rats. If the hybrids obtained from them are brought up in the same cage with a wild father, they remain quite wild all their life, as is evident from my own observations. Obviously, during their development they acquire from their wild father a whole series of conditioned reflexes. But if the hybrids are brought up without contact with their wild father, by a tame mother, they show no peculiar savageness. Laboratory rats which have lived in cages for many generations happen also to possess different degrees of taming. At our institute rats multiply "en masse," and are in contact with men only at the short moments when fed or when cages are cleaned. It is not very easy to take them in one's hands, since they are always likely to bite. In my special psychological laboratory rats were kept in a habitable room, where they continually see people, thus becoming notably tamer. During my work, I take young rats of three months into my hands without fear of being bitten, but when the daily work is finished and the rats are put into cages for mating, most of them grow shy.
>
> Out of the 200 rats I have worked with, only two—father and son—became so completely tame, that one could play with them as with kittens. Thus, while the influence of external conditions on the more or less intense manifestations of wild instincts is not to be denied, it is certain that here also a rôle is played by inherited capacities, that is, their genotypical peculiarities in respect to training.

The rats used in her experimental situations were descendants of animals derived from a wild male and an albino female. It was estimated that they had obtained approximately three quarters of their chromosomes from the wild male and an F_1 male derived from this wild and albino parentage. The other quarter came from the albino stock. All were trained on the Hampton Court maze. Although the usual records were kept, for some unexplained reason, only time scores for trials 3–13, inclusive, were used in the report. The time per trial varied from about 1 minute to 2 hours. From the data, it was concluded that there was no sex difference between the speed of the males and that of the females, and that positive and significant correlations existed between the time scores for maze-running of parents and offspring and likewise for sibs. This study is concluded with the suggestion that temperamental, rather than psycho-neural (intellectual), traits are measured and that a group of three genes were present: "(*a*) the gene of general activity; (*b*) the gene of the emotion, and (*c*) the gene of the seeking instinct."

What, we may ask in critically estimating the significance of Sadovnikova-Koltzova's reports, is the meaning of time scores on the maze? As Tolman and Nyswander (1927) point out, the time score is unquestionably a composite score and there is no acceptable way of determining the relative weights of its constituents. Now, to the components usually present in data from thoroughly tame animals, Sadovnikova-Koltzova adds the factors of wildness, savageness, and timidity in variable degrees by using strains of rats closely related to wild stock. What influence do these have upon the reliability of scores, the correlation of time and error scores, the net strength of the hunger motive, when opposed by the factors of wildness and timidity? These and many other questions must be answered by a more complete analysis of her total maze data, in our opinion, before she can safely differentiate phenotypical and genotypical variations in mixed strains of animals.

A first report of a "long-time" study of the wild Norway rat has just been published by King and Donaldson (1929). Although a total of 19 generations had already been observed, this report deals with only generations 1–10. The parent rats, captured in the city of Philadelphia, proved to be very wild and almost entirely intractable during their lifetime. They milled about frantically, cowered in the corners of the cage, or trembled and chattered when an experimenter approached. No matter how hungry they were, their appetites were curbed while the experimenter was present. Left to themselves, they quarreled and fought a great deal within the cage, pounced viciously upon all newcomers, and sometimes killed and ate their cage-mates. At every opportunity attempts at escape were made. When the door was opened, the rats sprang out with great vigor and suddenness; vulnerable places in the cages were found and enlarged sufficiently, by gnawing, to permit of escape. Most of the females failed to breed, and those that delivered young usually killed and ate them unless the offspring were immediately removed and placed with a tame foster-mother for rearing.

The first generation of laboratory-bred stock was found to be more susceptible to the taming influences of the environment than were the wild parent stock. As a rule, the F_1 young could be left with their parents without danger of being killed. Likewise, they could be removed for weighing or other laboratory tests without undue disturbance of the mother. Each generation now appears to be getting slightly tamer than the former; and, when regular handling is done from infancy, these animals are quite manageable, although still more excitable, tense, and savage than the laboratory stock of albinos. One characteristic that changes very little from the first to the tenth generation is the fighting tendency. It becomes most manifest when animals from one cage are transferred to the cage of others. At any time, the newcomer may be pounced upon and killed outright unless sufficiently strong and vicious to ward off the attackers. This "killer" tendency is prevalent among animals of both sexes.

The trend and present status of results for recent generations lead the authors to believe that without special selection descendants from this stock of Norway rats will become sufficiently tame that they may be employed in a wide range of experimental situations where other than the albino stock is desired.

From the reviewer's point of view, the information one should like most to have must come from a searching inquiry as to what portion of the behavior change reported for these wild rats might just as well have been obtained in the first laboratory generation if they had been handled by caretakers who already possessed the same interest, skill, and innocence of fear of being bitten that was probably present by the time the tenth generation had arrived. In short, the controls exercised do not appear to warrant any opinion as to why the succeeding generations are becoming more tractable than earlier ones were thought to be.

GROUP RATINGS FOR WILDNESS AND SAVAGENESS IN THE PRESENT STUDY

Differences with respect to avoidance, resistance to capture, biting, squeaking, etc., may be readily detected in strains of albino rats that have been handled from infancy as opposed to those that have been handled little or none up to the age of 30 or more days. Similarly, differences between albinos and descendants of wild strains may be observed without recourse to special rating techniques such as that employed by Yerkes. Yet the latter serve the purpose of setting forth in quantitative terms those features which so clearly and sometimes painfully distinguish the albino from its distant relative, the wild brown rat. In this experiment ratings of different strains for the behavior components listed in Table 4 have been made. Items 1-6, in our opinion, most clearly denote wildness, and items 7-11 denote savageness; but the fact that Yerkes considered squeaking as indicative of savageness as well as of wildness and timidity illustrates the point that such

TABLE 4

Items for Which Each Strain of Animals Was Rated

1. Resistance to catching in the home cage: running about the cage to avoid seizure by the experimenter's hand; clinging to the floor of the cage when caught; crowding behind or under other animals to avoid the experimenter's hand.
2. Tense muscles of the body, particularly the sides and abdomen while in the experimenter's hand.
3. Jumping, clawing, squirming, wriggling, etc., for the purpose of escaping from the experimenter's handclasp.
4. Squealing when caught or while being held.
5. Urination either in drops, jets, or a stream.
6. Defecation.
7. Biting the gloved hand when caught or as held in hand
8. Opening mouth, as if to bite or strike, but not actually biting.
9. Laying back ears.
10. Gnashing of teeth; chattering.
11. Hissing noise (somewhat like the hissing of a goose).

divisions are wholly arbitrary and, in a sense, are determined by each experimenter's opinion as to the connotation of the behavior under consideration. In the discussion which follows, such a difference of opinion may continue to exist without altering general conclusions, for all of our data are based on the composite or total score.

A three-point rating scale was used. Our zero point was fixed by the behavior of tame albinos such as those one is accustomed to enter upon maze experiments after considerable handling. The upper limit, or value 3, for a given item was set by the behavior of wild brown rats tested soon after they had been trapped and confined in the colony room. To illustrate, a stock albino taken from the cage usually rates 0 to 1 on the item "urination"; whereas a wild rat received the values 3, 2, or 1, according to whether a stream, dribble, or drop of urine appeared. On the item "biting," an albino merited a score of 0; whereas a brown rat received 3 for vigorous striking or repeated seizing of the glove, 2 for one vigorous bite, and 1 for a single nip. At any time the experimenter could check his impression of the extreme manifestations of wildness and savageness by examining tame albinos or recently trapped wild rats; yet to those who have attempted to use rating scales of the foregoing type it will be understood at once that some types of response listed in Table 4 yield more readily than others to a tripartite division and that the subjective element can never be entirely eliminated. For these reasons *one must always keep in mind the weaknesses inherent in this method as the results from its application are being considered.*

Ratings were recorded on animals placed in three standard situations on 10 consecutive days. The conditions or situations were as follows:

Situation No. 1.—Capturing and removing the rat from the home cage; holding him in one hand for 1–2 minutes while he was inspected for ear marks, tenseness of body, urination, etc.

Situation No. 2.—Placing the animal on the platform of a spring balance for weighing; releasing the hand while he was weighed; picking him up and again releasing him momentarily on a screen of hardware cloth, followed by immediate recapture; noting his eagerness to dart from the hand and the vigor of his efforts to escape; holding him by the root of the tail with one hand and stroking the back and head with the fingers, to offer occasion for attempts at escape or attacking the experimenter's hand.

Situation No. 3.—The animal, with others of his group, was given complete freedom on the floor of a small inclosure approximately 5×6 feet in dimensions. There he was allowed to remain without disturbance for approximately 30 minutes, after which he was recaptured and held in hand and placed on the screen of hardware cloth, as in situation 2, for an inspection lasting from 1 to 2 minutes.

These three situations, crude though they may be, elicit in a more or less systematic way the types of behavior which rats ordinarily display in connection with routine laboratory experimentation. Possibly different situations, however, might have brought out more clearly certain other latent differences between the wilder and the tamer strains. To illustrate, escape from the home cage on the part of an unhandled albino and a wild animal will nearly always reveal striking differences in their hiding tendencies, resistance to recapture, offensive savageness when cornered, and defensive savageness when recaptured and held in hand.

Ratings on all of the animals herein discussed, except the group of full-wild animals caught in a nearby basement, were made when the animals were between 3 and 4 months of age. No preliminary handling except removing the young at weaning time from the mother's cage, marking their ears, and transferring them to a larger home cage preceded the beginning of the rating experiment. Food was put into the cages without touching or disturbing the animals, and cages were cleaned without removing them. In short, all animals of this experiment reared in the laboratory were practically unhandled up to the day of the first rating.

Animals.—The animal groups embraced the following types, classified from the standpoint of hereditary strains: (1) wild animals trapped in a basement near a large hospital and within a residential district of Chicago, (2) wild brown rats descending from these trapped animals and reared in the laboratory, (3) first-generation crosses between the trapped animals and tame albinos, (4) crosses between the half-breeds and albino rats, (5) yellow-hooded animals, and (6) pure albino rats derived from the Wistar colony. In each group the number of males and females was approximately equal, although pains were not taken to make the number of each sex identical.

Data on ratings.—Taking as an animal's behavior score the sum of all ratings assigned to the items of Table 4 for a given day, we have obtained data by which comparisons of the wildness and savageness of the different strains might be made. Group A is the pure albino strain, and group C the yellow-hoods which have been in use as stock laboratory animals for some years. Group I consists of all of the quarter-wilds, massed without regard for coat color. Group DEF[1] is made up of the half-breeds, and Group G the full-blood wilds reared in the laboratory.

Percentage of total score derived from each item.—At the outset it may be of interest to know what percentage of the total score for the 10-day period of rating was derived from each of the items on which ratings were given. This is shown in Table 5. In the columns at the right will be found the total percentage of the score that is based on behavior indicating wildness, and likewise that indicating savageness. It will be seen that there is a gradual but slight shifting of the magnitude of the percentage denoting wildness toward that indicating savageness through the groups A, I, C, and DEF. Between groups DEF and G, however, the shift is large and in a sense abrupt. This is due to the relatively great increase in the scores received by the wild animals on the items "biting," "opening of the mouth," and "laying back ears."

MEAN RATING SCORES FOR SITUATIONS NO. 1 AND NO. 3

In Figure 1 we have graphically represented the mean scores for the respective groups on each of the 10 days for situation No. 1. As one familiar with these strains of animals would expect, the albinos occupy the lowest position on the scale and the full-wilds occupy the highest position. The half-breeds fall between these extremes. Only slightly higher than the albinos are the quarter-

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[1] The daily average ratings for groups E and F are superimposable for each of the three situations, and that of D falls only slightly below the other two. The difference is not sufficiently great to warrant giving it special consideration. Differences found between scores of the composite group DEF and any other group hold likewise, with only a few exceptions, for the groups D, E, or F considered individually.

TABLE 5

PERCENTAGE OF THE TOTAL SCORE DERIVED FROM EACH OF THE 11 ITEMS ON WHICH RATINGS WERE BASED

Group	Items on Which Ratings Were Made											Percentage of Total Score	
	Avoidance	Tense Muscles	Squirming	Squealing	Urination	Defecation	Biting	Baring Teeth	Hair Back	Chatter	Hissing	Wildness	Savageness
A $N=17$	20.2	35.2	22.5	5.3	11.4	2.1	0.8	1.6	1.0	0.0	0.0	96.6	3.4
I $N=30$	21.7	33.5	20.9	7.3	10.6	2.2	0.5	1.5	1.7	0.0	0.0	96.3	3.7
C $N=18$	25.5	30.9	12.9	10.1	9.6	5.5	1.0	1.7	1.6	0.0	0.0	94.5	5.5
DEF $N=70$	25.1	25.8	20.3	6.5	8.9	4.0	2.0	2.5	4.0	0.8	0.0	90.7	9.3
G $N=10$	18.2	18.1	17.3	9.9	8.7	2.3	6.4	8.5	10.3	0.4	0.0	74.5	25.5

wilds and the yellow-hoods, and much overlapping between individual scores of these three groups is found. On successive days each group received a lower score, which, if our deductions are correct, roughly indicates the relative tameability of these strains,

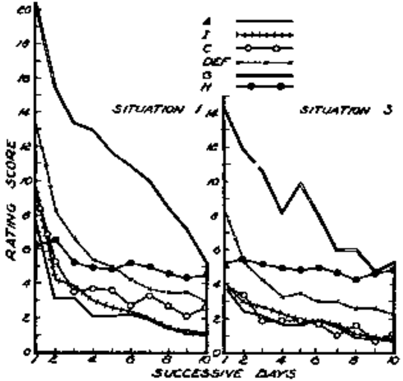

FIG. 1.—Mean rating scores of the respective groups for situations 1 and 3 on 10 successive days.

handled as we have stated above. Especially noteworthy is the great drop of the groups on the second day. Many of the albinos might have been handled safely by any experienced worker after the first day without the protection of gloves. Although the same could be said for the yellow-hoods and the quarter-wilds also, it was not true of either the full-wilds or the half-breeds.

TABLE 6

MEAN RATINGS RECEIVED BY EACH GROUP ON 10 SUCCESSIVE DAYS OF RATING IN SITUATION NO. 1

Group	Mean of Total Rating Scores on Successive Days									
	1	2	3	4	5	6	7	8	9	10
A N = 17	7.5 ± .60	3.1 ± .28	3.2 ± .20	2.1 ± .17	2.2 ± .18	2.1 ± .20	1.9 ± .21	1.4 ± .16	1.3 ± .15	1.1 ± .12
I N = 30	9.2 ± .43	4.2 ± .23	3.0 ± .20	3.0 ± .20	2.6 ± .18	2.4 ± .18	1.9 ± .17	1.5 ± .10	1.3 ± .10	1.0 ± .12
C N = 18	9.0 ± .64	5.3 ± .41	3.5 ± .41	3.3 ± .20	3.0 ± .48	2.7 ± .36	1.5 ± .34	2.7 ± .18	2.2 ± .25	2.6 ± .22
DEF N = 70	13.5 ± .37	8.3 ± .27	6.7 ± .13	5.4 ± .16	5.0 ± .16	4.2 ± .16	3.7 ± .12	3.5 ± .11	3.5 ± .11	3.0 ± .12
G N = 10	20.3 ± .71	15.5 ± .81	13.4 ± 1.23	13.0 ± 1.02	11.0 ± .77	10.9 ± .65	10.0 ± 1.14	8.5 ± .63	7.2 ± .73	5.3 ± .85

In Table 6, the mean scores made by groups A, I, C, DEF, and G on days 1–10 are given for situation No. 1. The albinos received the lowest mean ratings, on the whole; but the ratings of group I exceed them by only small and, for the most part, nonsignificant amounts (see Table 7). The ratings of the yellow-hoods are consistently higher than those of the albinos or the quarter-breeds. All differences between groups A and C except those of the first, third, sixth, and ninth days suggest statistical significance

TABLE 7

Groups	Ratings on Successive Days									
	1	2	3	4	5	6	7	8	9	10
A vs. I	2.17	3.11	2.37	3.59	1.80	0.66	0.48	0.52	† 1.05	† 0.17
A vs. C	1.65	4.43	9.64	4.55	3.77	1.33	3.52	5.30	2.55	6.16
A vs. DEF	8.15	14.58	11.80	14.80	[illegible]	7.85	7.71	11.26	12.53	11.53
A vs. G	12.96	14.13	8.10	10.55	12.68	12.70	7.01	10.92	7.92	4.92
I vs. C	† 0.30	1.32	† 0.74	1.80	2.10	0.80	3.30	5.57	3.62	6.28
I vs. DEF	8.37	12.99	9.63	9.11	10.20	7.75	8.50	13.00	14.87	11.70
I vs. G	13.38	18.15	7.04	9.57	11.41	13.77	6.95	10.93	8.27	4.05
C vs. DEF	0.52	4.10	6.75	5.27	4.09	4.00	1.21	4.14	5.60	1.08
C vs. G	11.77	10.27	7.62	8.80	9.08	11.21	5.65	8.83	6.08	3.06
DEF vs. G	8.05	8.35	5.33	7.37	8.51	9.94	5.40	7.75	5.05	2.64

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(Table 7). Between groups C and I, however, the differences are insignificant except on trials 7–10, inclusive. These differences on the last days probably indicate that the taming process proceeded more rapidly in the quarter-breeds than in the yellow-hooded animals. Half-breeds DEF received much higher ratings on the whole than either A, I, or C. With only a few exceptions, the daily differences are statistically significant. Differences between the full-wild and the half-breeds are even greater than those between the half-breeds and the albinos, and on all but the tenth day the differences are statistically significant.

The mean scores for situation No. 2 bring out approximately the same group differences already discussed in connection with the data of situation No. 1; hence, to avoid unnecessary printing of tabular material, these data will be omitted. The means for each group are slightly lower in this situation than those for situation No. 1, but the decline from day to day has approximately the same relationships from group to group.

On the right in Figure 1 is given the mean ratings for situation No. 3; the numerical data on which they are based are given in Table 8. It may be seen that in this, as compared with situation No. 1, the means have dropped perceptibly for each of the groups, yet the same relative relationships for the more widely separated groups persist. Differences between the albinos, quarter-breeds, and yellow-hoods are small, inconsistent, and, almost without exception, non-significant (see Table 9). On the other hand, the differences between these three relatively gentle groups and the full- and half-wild animals are fairly large and statistically significant, as shown by the data of Table 9. Likewise, the scores of the full-wilds are significantly larger than those for the half-wilds.

These data strongly suggest that the foregoing differences in wildness and savageness measured by this rating scheme have a hereditary foundation, rather than that they are conditioned by dissimilar environments. As we have previously stated, the treatment of all the animals was intentionally similar with respect to feeding, housing, and avoidance of special taming factors of the surroundings, such as tactual contact with man; hence, those aspects of the environment were not conducive to producing dissimilarities. Excepting the full-wilds, all mothers were sufficiently tame and gentle for routine animal experimentation; and although we cannot deny the possibility of full-wild mothers conditioning their young for the traits of wildness and savageness during the nursing period, we do have some evidence to show that full-wild young, when reared by albino mothers from birth, yield rating scores which approximate the mean of their genetic strain rather than the mean of the foster-mother or foster-litter-mates. A few albinos similarly placed with a full-wild mother and young were not wilder or more savage than other albinos reared in the usual way. Corroborating this point is the finding of King and Donaldson (1929), who placed the full-wild young with tame albino

TABLE 8

MEAN RATINGS RECEIVED BY EACH GROUP ON 10 SUCCESSIVE DAYS OF RATING IN SITUATION NO. 3

Group	Mean Ratings on Successive Days									
	1	2	3	4	5	6	7	8	9	10
A $N=17$	3.9±.37	2.4±.19	2.2±.20	1.7±.22	2.0±.17	1.9±.18	1.5±.10	0.9±.18	0.8±.14	0.7±.10
I $N=30$	4.0±.27	2.9±.23	2.7±.25	2.3±.16	2.9±.17	1.9±.22	1.7±.13	1.1±.12	0.9±.10	0.7±.09
C $N=18$	3.9±.46	3.4±.34	1.9±.30	1.9±.27	2.9±.25	1.7±.20	1.0±.15	1.6±.25	0.7±.18	1.4±.21
DEF $N=70$	8.3±.22	5.3±.18	4.3±.20	3.3±.16	3.5±.14	3.0±.16	3.0±.12	2.6±.12	2.6±.10	1.5±.09
G $N=10$	14.2±.96	11.8±.82	10.7±1.12	8.3±.50	10.0±1.09	8.2±.69	6.0±.64	6.1±.57	4.8±.47	5.3±.82

mothers in order to prevent their being killed. These first-generation young, although somewhat more tameable than their trapped parents, were, nevertheless, much wilder than albinos similarly reared.

The daily drop in mean scores for situations No. 1 and No. 3 on 10 consecutive days, and likewise the drop in situation No. 3 as

Groups	Ratings on Successive Days									
	1	2	3	4	5	6	7	8	9	10
A vs. I	0.21	2.26	2.96	2.00	2.53	0.23	0.52	3.13	0.47	0.60
A vs. C	0.08	2.67	†0.80	0.41	0.97	†0.30	†2.21	3.24	†0.55	3.57
A vs. DEF	12.43	12.25	7.50	5.74	8.45	4.54	6.12	7.82	10.41	12.09
A vs. G	10.27	11.33	7.46	10.43	12.83	8.77	4.31	8.32	8.10	5.55
I vs. C	†0.22	1.40	†2.35	†1.22	0.10	†0.80	†3.42	3.44	†0.76	3.26
I vs. DEF	15.28	10.41	6.44	4.30	7.00	5.20	7.09	8.09	12.07	12.35
I vs. G	10.46	10.82	7.08	9.88	11.38	8.82	9.45	8.58	8.16	5.53
C vs. DEF	8.61	4.03	6.69	4.48	5.41	4.77	10.20	5.72	8.81	7.86
C vs. G	9.73	9.59	7.90	9.86	11.11	8.86	10.87	7.83	8.16	4.01
DEF vs. G	6.04	7.81	5.01	8.28	9.34	7.24	6.63	6.05	4.65	3.03

* P.E.diff. *

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compared with situation No. 1, roughly indicates the tameability of these strains of rats. The graphs of Figure 1 may be considered crude "taming" curves. That they are crude, however, must not be overlooked, because it is probable that the reduction of wildness and savageness for the three situations of this experiment are not perfectly correlated with reduction for all life-situations; furthermore, the strength of the subjective elements in the rating scores cannot be determined.

VARIABILITY OF RATINGS

The standard deviations of the distributions of ratings for each group in situation No. 1 on each of the 10 days are given in Table 10. With respect to variability of scores about the means,

TABLE 10

STANDARD DEVIATIONS OF THE RATINGS RECEIVED BY EACH GROUP ON 10 SUCCESSIVE DAYS OF RATING IN SITUATION NO. 1

Group	Mean Ratings on Successive Days									
	1	2	3	4	5	6	7	8	9	10
A $N=17$	4.9±.49	2.0±.20	1.2±.14	1.0±.11	1.0±.13	1.1±.13	1.2±.15	0.9±.11	0.9±.11	0.7±.08
B $N=30$	2.8±.30	1.8±.16	1.5±.14	1.5±.14	1.8±.12	1.4±.15	1.3±.12	0.8±.07	0.8±.07	0.9±.08
C $N=18$	4.0±.45	2.7±.30	2.7±.30	1.8±.21	1.7±.31	2.7±.24	2.1±.24	1.1±.13	1.6±.18	1.4±.16
DEF $N=50$	3.5±.10	2.8±.16	3.0±.16	2.2±.11	2.1±.13	2.0±.11	1.6±.09	1.5±.08	1.5±.08	1.5±.08
G $N=10$	3.5±.50	3.9±.50	5.8±.87	4.8±.72	3.6±.55	3.1±.69	5.4±.81	2.9±.45	3.4±.51	4.0±.60

groups A and I are slightly less variable than groups C, DEF, and G, on the whole. Group C does not differ significantly from the half-breeds, but on certain days it differs significantly from the full-wilds; and all differences, with the exception of those for the first day, are in the same direction (see Table 11). With the exception of days 1, 2, 5, and 6, group DEF differs significantly from group G, the full-wilds as shown by the data of Table 11.

TABLE 11

SIGNIFICANCE OF THE DIFFERENCES BETWEEN THE SIGMAS OF THE RATINGS

GROUP	RATINGS ON SUCCESSIVE DAYS									
	1	2	3	4	5	6	7	8	9	10
A vs. I	†2.91	0.73	1.60	2.73	1.77	2.38	0.36	†1.00	†0.53	2.81
A vs. C	0.94	3.17	4.61	3.63	5.03	3.89	3.50	1.35	3.50	3.89
A vs. DEF	†0.89	4.85	8.62	7.31	5.10	5.29	8.22	4.21	4.93	7.82
A vs. G	†0.94	3.73	5.24	5.17	4.54	7.81	5.06	4.48	4.90	4.41
I vs. C	2.18	2.70	3.63	1.40	4.71	2.96	3.37	2.40	4.21	2.77
I vs. DEF	1.88	4.65	7.09	3.61	3.55	3.82	2.26	6.54	6.96	6.06
I vs. G	0.84	3.47	4.87	4.50	4.05	2.45	4.97	4.76	5.13	5.08
C vs. DEF	†2.02	0.35	0.83	1.15	†1.83	†0.58	†2.25	2.40	†0.20	0.80
C vs. G	†1.03	2.77	3.36	3.92	1.40	1.16	3.77	3.89	3.37	4.19
DEF vs. G	†0.36	1.72	3.18	3.62	2.62	1.53	4.00	3.20	3.58	4.00

* In each column the $\frac{D}{P.E._{diff.}}$ is given for the sigmas of the groups compared. The dagger (†) signifies that the sigmas of the first-named group are the larger.

In Table 12 are given the standard deviations of the distributions for each group in situation No. 3 on each of the 10 days. Differences between the sigmas of groups A and I are insignificant and inconstant as to direction (see Table 13). Between groups A and C the differences are suggestive of significance on the first third of the rating period but not thereafter. As compared with groups DEF and G, group A is less variable; on the whole and generally speaking, the differences either are significant or suggestive of statistical significance. What we have just said for group A may be repeated in the main for group I as compared with the other groups. Differences between the variability of group C and that of either DEF or G are in the same direction

TABLE 12

STANDARD DEVIATIONS OF THE RATINGS RECEIVED BY EACH GROUP ON 10 SUCCESSIVE DAYS OF RATING IN SITUATION No. 3

GROUP	RATINGS ON SUCCESSIVE DAYS									
	1	2	3	4	5	6	7	8	9	10
A N = 17	1.5±.19	1.1±.13	1.1±.13	1.3±.16	1.0±.11	1.0±.13	1.1±.15	1.0±.13	0.8±.10	0.6±.07
I N = 30	1.5±.12	1.1±.10	1.1±.10	1.2±.11	1.3±.12	0.9±.08	0.9±.08	0.9±.09	0.8±.07	0.7±.06
C N = 18	2.9±.32	2.1±.24	1.9±.21	1.7±.19	1.6±.18	1.2±.14	0.9±.11	0.8±.13	1.1±.12	0.7±.08
DEF N = 70	2.9±.16	2.4±.13	2.6±.14	2.1±.11	1.8±.10	2.0±.11	1.6±.09	1.6±.09	1.3±.07	1.2±.07
G N = 10	4.5±.67	3.8±.57	5.3±.79	2.8±.41	3.3±.49	3.3±.49	2.1±.31	2.7±.40	2.2±.33	3.9±.59

but, for the most part, not statistically significant in the early days of rating, although on the later days some of the differences approach statistical significance (Table 13). Here, again, we have the influence of the taming factor playing its differentiating rôle. Some of the half-breeds and the full-wilds did not tame as rapidly as the majority of yellow-hoods; hence, variability in the group of full-wilds was not decreased as rapidly as in the yellow hoods.

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GROUP	RATINGS FOR SUCCESSIVE DAYS									
	1	2	3	4	5	6	7	8	9	10
A vs. I	0.88	0.18	0.17	0.53	2.00	0.89	1.22	0.50	0.61	0.55
A vs. C	3.68	3.81	3.08	1.64	3.05	1.16	†0.88	†1.06	1.69	1.00
A vs. DEF	5.44	7.28	7.95	4.37	5.93	5.05	3.13	3.38	4.17	4.40
A vs. G	4.13	4.07	5.18	3.77	4.62	4.29	2.83	4.00	3.97	5.54
I vs. C	4.67	3.84	3.08	2.32	1.45	2.31	0.50	†0.62	2.50	0.60
I vs. DEF	7.05	8.00	8.15	6.10	3.56	7.97	6.00	5.86	5.80	6.55
I vs. G	4.69	4.03	5.14	3.65	4.62	4.08	3.08	4.31	4.50	5.45
C vs. DEF	0.00	1.04	2.96	1.01	1.10	4.11	4.64	4.36	1.64	4.82
C vs. G	2.16	2.71	4.11	2.30	3.22	3.80	3.36	4.45	3.09	5.27
DEF vs. G	2.32	2.41	3.29	1.40	2.84	2.46	1.44	2.78	2.90	4.40

mpared. The dagger (†) sig-

The half-breeds are consistently less variable than the full-wild group on situation No. 3, but the probable errors are so large that only on a few days is statistical significance found (see Table 13).

OVERLAPPING OF GROUPS

To illustrate the amount of overlapping of the various groups, the frequency polygons shown in Figure 2 have been made from the total scores for the 10 days' rating on situations No. 1 and No. 3. It may be seen that there is almost no overlapping between the three groups—albinos, quarter-breeds, and yellow-hoods—on the one hand, and the full-wilds on the other. An intermediate position is occupied by the half-breeds which overlap the three groups, A, I, and C, and likewise the full-wilds, group G.

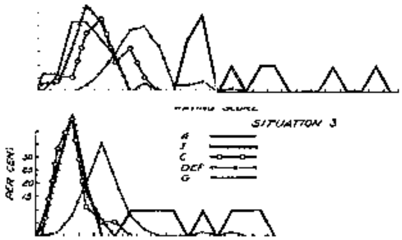


FIG. 2.—Comparable frequency polygons illustrating the overlapping of groups

MEAN RATINGS ACCORDING TO COAT COLORS IN THE QUARTER-BREEDS

In Figure 3 are given the mean ratings for the quarter-breeds according to coat color. There were 15 of the albinos—4 browns, 6 blacks, and 5 hooded animals. Obviously, the number in each group is entirely too small for anything but the most tentative suggestions concerning the relationship between coat color and the traits wildness and savageness; yet, since the mean rating of each group fluctuates only very little from the average for all of the quarter-breeds, the data are worthy of consideration. Clearly, those of the browns, the blacks, and the hooded animals do not rise to the level of the brown half-breeds or the full-wilds (see Figure 1). Their behavior was in keeping with the hypothesis that they, as a group, inherited less of those temperamental traits expressed in wildness and savageness than was inherited by their half-breed sires; also, it suggests that coat color is not linked with the temperamental traits in question.

By throwing together all of the quarter-breeds with pigmented coats, the number of cases is equal to that of the albinos. Means and sigmas for the pigmented and albino are given in Table 14 and the means are plotted in Figure 3. The significance of the differences between these means and sigmas are indicated in Table 15. Differences between means of these groups are small, inconstant as to direction, and, for the most part, statistically insignificant. Thus, for the quarter-breeds, there is nothing to suggest that savageness and wildness are linked with coat color.

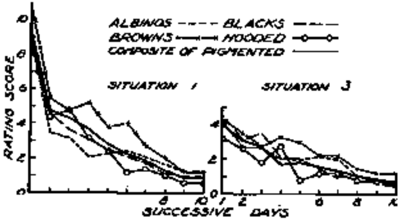


FIG. 3.—Mea ores of the quarter-breeds distributed as to ·

A more satisfactory approach to this problem might have been one in which promiscuous interbreeding of the half-breeds was permitted for the purpose of producing an F_2 generation with differences in coat color. Since wildness and savageness are more pronounced in half-breeds than in quarter-breeds, the rating scale could be employed more accurately with them because one is not constantly dealing with the mild manifestations of the traits in question. Our original plan called for an extensive experiment of this kind, but unexpected delay in securing our original stock of

TABLE 14

MEANS AND STANDARD DEVIATIONS OF THE RATING SCORES OF ALBINO AND PIGMENTED QUARTER-BREEDS FOR SITUATIONS NO. 1 AND NO. 3

(Number of Albinos, 15; Pigmented, 15)

Group	Ratings on Successive Days									
	1	2	3	4	5	6	7	8	9	10
	Means for Situation No. 1									
Albinos	8.9±.27	3.4±.28	3.2±.23	2.2±.22	2.3±.18	2.4±.24	2.2±.27	1.7±.25	1.8±.15	1.2±.15
Pigment	9.5±.37	4.5±.38	4.3±.27	3.7±.23	2.8±.27	2.3±.20	2.0±.22	1.3±.18	0.9±.23	0.6±.13
	Standard Deviations for Situation No. 1									
Albinos	3.5±.51	1.4±.20	1.2±.16	1.1±.16	0.9±.12	1.2±.17	1.3±.19	0.8±.11	0.8±.11	0.7±.10
Pigment	2.1±.26	2.2±.27	1.5±.19	1.5±.23	1.0±.19	1.5±.18	1.2±.15	0.7±.09	0.8±.10	0.8±.10
	Means for Situation No. 3									
Albinos	4.0±.17	2.7±.20	2.6±.08	2.4±.27	2.0±.15	2.4±.13	2.0±.17	1.1±.22	0.9±.18	0.7±.13
Pigment	4.0±.27	3.1±.21	2.7±.13	2.4±.19	1.9±.27	1.6±.15	1.4±.14	1.1±.14	0.9±.15	0.7±.12
	Standard Deviations for Situation No. 3									
Albinos	0.9±.12	1.0±.14	0.4±.06	1.3±.19	0.7±.11	0.6±.09	0.9±.12	1.1±.16	0.9±.13	0.6±.09
Pigment	1.5±.19	1.1±.15	1.3±.16	1.1±.11	1.5±.19	0.9±.11	0.8±.10	0.8±.10	0.6±.08	0.7±.08

half-breeds and the desirability of using all obtained in our rating test, concealment test, and maze experiment made it impossible to carry through this plan in the time at our disposal.

TABLE 15

SIGNIFICANCE OF THE DIFFERENCES BETWEEN THE MEANS AND THE SIGMAS OF THE ALBINO AND THE PIGMENTED QUARTER-BREEDS*

Group	Ratings in Successive Days									
	1	2	3	4	5	6	7	8	9	10
Mean 1	0.69	2.16	3.27	5.18	1.03	†0.44	†0.46	†2.04	†1.71	†1.26
Mean 5	0.90	1.17	0.04	0.04	†0.47	†1.83	†1.92	0.02	0.07	0.09
Sigma 1	†2.50	±.35	1.69	1.11	3.12	1.35	†0.03	†0.04	0.01	0.04
Sigma 5	31.12	1.07	5.15	†1.00	3.05	1.64	†0.03	†1.16	†1.85	0.05

SEX DIFFERENCES IN WILDNESS AND SAVAGENESS

In only one group, the half-breeds, is the number of cases sufficient to warrant our making comparisons of the ratings of males and females. Table 16 gives the means and the standard deviations of the rating scores for the two sexes of half-breeds. It will be seen that, for the most part, differences in means are small, inconstant as to direction from the first to the tenth day of rating, and statistically insignificant (see Table 17). As to variability, the differences are likewise small, variable as to direction, and, for the most part, non-significant. Hence, the conclusion most consistent with the data at hand would be to the effect that male and female half-breeds display about the same degree of wildness and savageness in the rating situations employed in this experiment. Our tentative conclusion coincides with that of Yerkes for his F_2 generation, but not with that for the F_1 generation of hybrids.

TAMEABILITY OF ADULT WILD ANIMALS

Group H, to which we have not referred hitherto in this section, is a small group of adult wild animals which were rated about 6

Sex Differences between the Ratings of Males and Females of the Half-Breed Group

(Number of Males, 40; Females, 30)

Group	Ratings on Successive Days									
	1	2	3	4	5	6	7	8	9	10
	Means for Situation No. 1									
Males	13.4±.37	8.3±.26	6.7±.31	5.4±.21	4.6±.21	3.9±.18	3.5±.15	3.3±.11	3.2±.12	2.8±.11
Females	13.4±.41	7.7±.42	6.9±.34	5.3±.25	5.6±.24	4.7±.26	4.0±.2[illegible]	3.9±.21	3.8±.22	3.5±.22
	Standard Deviations for Situation No. 1									
Males	3.9±.18	2.5±.18	3.0±.22	2.2±.16	2.0±.15	1.7±.13	1.4±.10	1.1±.09	1.2±.09	1.0±.08
Females	3.5±.29	3.6±.30	2.9±.24	2.1±.17	2.2±.17	2.2±.19	1.8±.15	1.8±.15	1.9±.16	1.8±.15
	Means for Situation No. 3									
Males	7.4±.28	4.8±.19	3.8±.19	2.8±.17	3.1±.16	2.6±.15	2.5±.15	2.6±.16	2.4±.12	2.0±.09
Females	7.3±.37	6.0±.33	5.0±.37	3.9±.32	4.0±.24	3.4±.20	3.3±.19	2.6±.19	2.8±.18	2.9±.17
	Standard Deviations for Situation No. 3									
Males	2.7±.19	1.8±.13	1.9±.14	1.6±.12	1.5±.11	1.4±.11	1.4±.10	1.5±.11	1.2±.08	0.9±.06
Females	3.2±.26	2.8±.23	3.1±.26	2.6±.22	2.3±.17	2.5±.20	1.6±.14	1.6±.13	1.5±.13	1.5±.12

months after their capture. During the half-year of captivity they were handled (with gloves) a great deal in connection with the repeated examination of females for pregnancy, transference from one to another breeding cage, and special experiments requiring that they be removed temporarily from the home cage. At the outset all of them were exceedingly wild, savage, and dangerous to handle even with heavy gloves; but gradually they became more and more tractable with successive months of captivity. None of them, however, ever displayed in the presence of the experimenter that typical freedom of movement in the home cage which one ordinarily finds in albino breeding stock. All would immediately scurry for a hiding place if put down upon the floor.

TABLE 17

SIGNIFICANCE OF THE DIFFERENCES BETWEEN MEANS AND SIGMAS OF THE RATING SCORES OF MALES AND FEMALES OF THE HALF-BREED GROUP*

GROUP	RATINGS ON SUCCESSIVE DAYS									
	1	2	3	4	5	6	7	8	9	10
Mean 1	†0.07	†1.20	0.41	0.21	0.09	2.60	1.92	2.17	2.40	2.64
Mean 3	0.20	2.03	2.76	3.15	3.07	2.42	3.97	0.08	2.00	4.63
Sigmas 1	†0.93	1.97	0.45	0.30	0.36	2.52	1.11	3.82	3.76	4.72
Sigmas 3	1.30	3.73	4.17	3.84	2.80	4.04	1.24	0.35	2.47	4.09

The curve for group H given in Figure 1 illustrates their status of wildness and savageness after 6 months of taming as compared with that of the other younger groups which had scarcely been handled at all prior to the time their rating began. Their rating on situation No. 1 was about the same on the first day as that of the albinos and somewhat lower than that of the other groups. In situation No. 3, however, their mean starts much higher than that of the albinos, the difference arising from a greater resistance to recapture offered by the wild animals. After the first day there was only a slight decline in the curve of the wild but a sharp and consistent fall in that of the albinos. Laboratory-bred wild stock closely approximate, after 10 consecutive days of rating, that level reached by trapped wild animals in the course of 6 months of cage confinement and unsystematic handling.

The chief conclusions reached in the foregoing rating experiments are as follows:

1. Untamed albino rats of the Wistar stock are slightly less wild and savage than quarter-breeds (albino × half-breeds) and yellow-hoods of the stock colony when rated at the age of approximately 3–4 months. These three groups, in turn, are notably less wild and savage than half-breeds (albino × wild) or full-wild when all are reared under similar conditions. Full-wilds receive higher ratings than the half-breeds.

2. Differences in variability of rating scores for the groups studied are relatively small. On the whole, however, the albinos and quarter-breeds were the less variable. Probably, full-wilds are the most variable.

3. There is little overlapping between rating scores of the full-wilds and the three groups: albinos, quarter-breeds, and yellow-hoods. The half-breeds occupy an intermediate position.

4. Within the quarter-breed group the data, too few in number for any generalization, indicate that coat colors are associated with varying degrees of wildness and savageness, rather than that there is a genetic linkage of the factors underlying hair pigment and these temperamental traits.

5. No substantial sex difference was found in the wildness and savageness of the half-breeds. The number of cases in the other groups was inadequate for statistical analysis on this point, but an inspection of the data revealed no trend in favor of one or the other sex.

6. Differences in the trait of wildness and savageness were clearly displayed by our half-breeds and full-wilds as compared with the albinos, quarter-breeds, and yellow-hoods prior to the age of 20 days. This fact, together with that of the persistent difference shown in later life, strongly suggests that the differences arise from hereditary rather than environmental factors.

DOMINANCE OF THE HIDING TENDENCY OVER HUNGER

One of the outstanding characteristics of captured wild rats is their tendency to crouch against the walls of their cages or to seek cover when opportunity for concealment is offered. Although this tendency may be noted sometimes in the stock colony of albino rats, seldom is it manifested to the same degree as that found in trapped, wild stock or their progeny. In order to obtain a comparable basis of contrasting the wild, the albinos, and the mixed strains as to the strength of their hiding tendency, a simple experimental situation was devised. In this a hungry animal might either appease his appetite by running from a starting-box to a food box via a concealment chamber, or he might conceal himself inside this chamber. In a sense, the hunger motive is pitted herein against the concealment motive.

In Figure 4 the apparatus is illustrated. The starting and goal boxes are made of wood and hardware cloth. The labyrinth consists of black stovepipe. A door (D_1) is placed at the entrance and can be closed as soon as the animal enters the stovepipe. Also, a door (D_2) in the goal box is so placed that, when it is closed, the animal cannot re-enter the stovepipe after he has passed into the main chamber of the food box. Immediately in front of the food receptacle (*F*) there is a small pedal (*P*) on which the rat must tread as he moves out to the food container. By depressing the pedal, an electrical contact is made which activates a door buzzer. The latter signifies to the experimenter that the animal has completed the circuit, whereupon he closes door 2 and traps the animal in the food box. There are no tricks to be mastered in this problem, and in no appropriate sense of the term may it be considered a maze experiment. Any animal which proceeds cautiously but continuously, as does the tame albino, will ordinarily complete its first circuit in from 30 to 60 seconds; and a rat running without any inhibitions may reach the food in 3 to 5 seconds.

As a rule, no food was given the animals for a period of 48 hours prior to the first trial on the concealment experiment. Thus, hunger motivation was always at a high pitch. Group E, as previously stated, also underwent a weight reduction (approximately 10 per cent) during the previous 10 days while on the rating experiment in order that they might be brought to a state of chronic inanition before the beginning of the present tests. If the animal failed to complete the circuit within 10 minutes, the test was considered a failure for that day and no food was given.

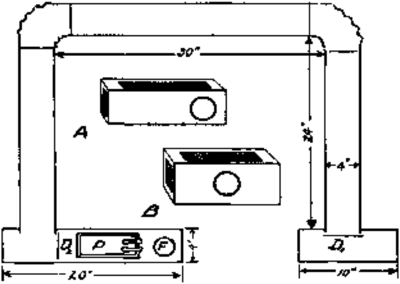


FIG. 4.—Concealment apparatus. A, food box; B, starting-box

ANIMAL GROUPS

The animal groups of this experiment are the same as those we have previously discussed in the rating section, with two exceptions. Group B is composed of 18 yellow-hooded animals which, although not handled as required in the rating scheme, were fondled a few seconds daily in their home cages for about 2 weeks before the stovepipe experiment began. On the whole, they appeared to be somewhat tamer than the yellow-hoods, which received only the manipulation involved in the regular rating scheme (see page 15). Group Aa consists of the albino group of the rating experiment and 20 additional albinos which were regularly handled as was group B in their home cages for approximately 2 weeks prior to this experiment. The data for these 20 individuals were so similar to those of the rated albinos that the two groups were combined to simplify graphical illustration, tabulations, and discussions of results. Group D is a normal group of half-breeds; group E, the chronic inanition group, while on this test series was subjected to a degree of weight reduction similar to that of the other groups; group F was blind. Since the special conditions imposed upon the half-breeds brought different results, the groups must be considered separately. Group I is made up of the quarter-breeds, combined without respect for color. Group G consists of the full-wilds.

RESULTS FROM THE STOVEPIPE EXPERIMENT

In Figure 5 is graphically represented the percentage of individuals in each group that sounded the buzzer within 1 minute from the time they left the starting-box. On the right side of the figure is given the percentage of cases passing over the platform to reach the food at the other end of the box. The number of cases sounding the buzzer is usually greater than the number going on to reach the food. Some individuals, particularly in the early trials, darted back into the stovepipe immediately upon depressing the platform that sounded the buzzer. Figure 6 represents the percentage of cases failing to come into the food box in 10 minutes.

It may be observed that about 65 per cent of the albinos sounded the buzzer and reached the food within the first minute of trial 1. Thereafter, about 95 per cent of the cases did the same within 1 minute. Next to the albino group are the quarter-breeds and half-breeds, group E. From the yellow-hooded animals two kinds of results were obtained. Many individuals of group B, fondled daily for 2 weeks prior to this experiment, were very unwilling to come out in the early trials, but they improved steadily in this respect from day to day; their percentage score closely resembles that of the half-breeds, group D. Both were reluctant to appear until they had been deprived of food for a few days. Group C, the yellow-hoods which had been in the rating experi-

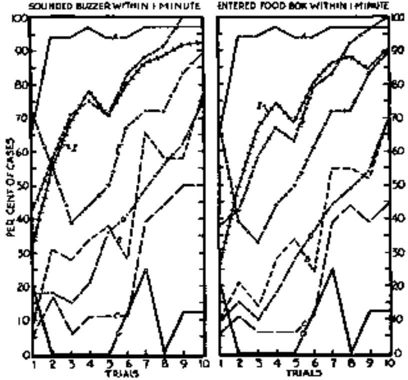


FIG. 5.—Percentage of cases in each group that reached and entered the food compartment within 1 minute.

ment, had a stronger hiding tendency than group B, the yellow-hoods which had been handled and fondled in the home cage for about 2 weeks. Group E is particularly interesting because it indicates that very strong hunger motivation will prevail over the strong hiding tendency. Starting high, as compared to other half-breeds, its percentage of individuals coming around in the first minutes of the experiment rapidly increased from test to test. Group F is also particularly interesting because the animals are without vision. Not being able to see the experimenter who stood quietly in the room near the site of the apparatus, these animals,

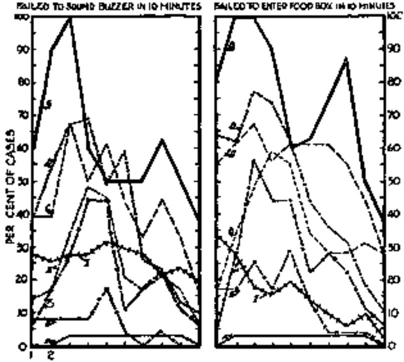


Fig. 6.—Percentage of e ach group that failed to enter the food box within

as a group, came around on the first trial about as the albinos did. Like the others, they were trapped in the food box after the first circuit, and eventually caught by the experimenter. This experience produced a different effect upon them than it did on the albinos, as is shown by the drop of their curve for the next days and by the increase in the percentage of animals that did not come around at all in the 10-minute interval. Food deprivation for failures, however, resulted in the hunger factor dominating the hiding tendency once more, thus increasing the percentage of individuals coming around for food. Why, we may ask, did group F not stay in hiding to the same extent as group D, which they closely resemble as to state of nutrition? In my opinion the differentiating factor is largely that of vision. When the hungry animals of group D came around to the food box where they were exposed to the view of the experimenter, their timidity increased sufficiently to overcome hunger motivation, with the result that they turned back into the tube or stopped just at the entrance to the food box, where they might avoid being trapped or could dart quickly out of sight and reach of the experimenter. The blind animals, however, did not have this visual factor of countermotivation working against hunger. Once they came into the food compartment, the door was immediately dropped behind them, so that escape was impossible.

Most reluctant of all to come around was the full-wild group. Not being fed during the first days, because of failures, many of them became even more acutely in need of food than the animals of group E. As the figure suggests, a small percentage of the wild animals eventually began to come around regularly within the first minute of time; others, however, did not come around a single time during the whole 10-minute period on any of the 10 days. In them the concealment tendency was undoubtedly stronger than that of either of the other groups tested.

HIDING RESPONSES IN OTHER SITUATIONS

A cage response that is fundamentally like that of the concealment response described in the foregoing experiment may be observed at any time in trapped wild rats for many months after their confinement, and likewise is frequently displayed by halfbreeds or full-wilds reared in the laboratory. This is the tendency to press the body against the wall of the cage and, by counterpressures of the body, to resist being dislodged therefrom. We have exerted pressures to move these trapped wild animals by means of an aesthesiometer with an especially prepared blunt end. Usually a pressure in excess of 500 grams was required to move an animal weighing no more than 180 grams. Wild rats, as a rule, will remain immobile when pricked or probed with a dissecting needle, once they have firmly locked themselves against a cage wall. Merely touch an albino, on the other hand, and it moves away at once or turns to bite at the instrument. Although half-breeds and full-wild animals reared in the laboratory displayed much less of this cage-hiding tendency than the trapped wild ones, the strength and the prevalency of this tendency, nevertheless, was still much greater than that of the albinos.

An albino escaping from the home cage may be captured, as a rule, with but little effort; not so with the half-breeds and the full-wilds unless the latter have undergone a considerable amount of taming. They scurry at once for a place of concealment and will seldom be found loitering about or sitting upon the home cage, as are the albinos. If wild stock escapes from the home cage in a rat-proof room, one may profitably begin his search to reclaim them by examining desk drawers, cupboards, niches in the wall, or crevices behind radiators, etc. In general, I believe we may say that the greater strength of this concealment tendency in wild stock, as brought out by the stovepipe experiment, typifies the stronger manifestation of this tendency in life-situations.

SUMMARY OF RESULTS

1. When ranked according to the ascending order of strength of the hiding tendency, as measure by the concealment test, our groups stand as follows: albinos, quarter-breeds, yellow-hoods and half-breeds, and full-wilds.

2. The degree of hunger required to displace the concealment tendency roughly varies with the latter's strength.

3. It would seem that the stronger manifestation of the hiding tendency by full-wilds as compared with the domestic albinos corresponds fairly well with their stronger manifestation of this tendency in the free state.

MAZE-LEARNING

In order to determine the influence of timidity and wildness upon maze performances, the groups of the foregoing experiments were given maze-training under typical laboratory conditions.

APPARATUS AND METHOD

A maze of simple design extensively used by Lashley and his students was employed in this experiment (see Figure 7). The turns are alternately left and right; and since doors do not intervene between the points of entrance and exit, retracing ad libitum is permitted. Typically, a fair degree of mastery may be attained by tame animals within 8 to 15 trials.

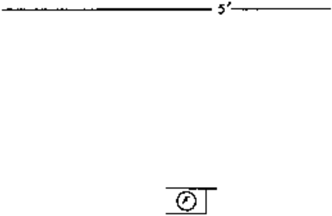


FIG. 7.—Floor plan of the maze (Lashley's design)

Each animal received 3 trials per day with an interim of approximately 20 minutes intervening between trials in which the animal remained in his home cage. Only a nibble of food was permitted after the first and second trials, and the day's ration followed trial 3. Under this condition animals are active and persistent in their attempts to solve the maze, except when timidity and the hiding tendency dominate all others. Very timid and wild animals ordinarily refuse to run the maze at all.

That hunger motivation was unequal for some of the groups and for individuals within each group is almost certain. The full-wilds (group G) had already undergone acute and chronic inanition in connection with the stovepipe experiment because many of them refused to leave the concealment passage to obtain food; similarly and for the same reason, many of the half-breeds and yellow-hoods failed to earn their daily food reward. The albinos on the other hand, with few exceptions, obtained their food reward each day. Hence, even though the daily ration issued to the albinos was restricted in amount, the total received during 10 days preceding the maze experiment was unquestionably greater than that of the other groups. This uncertainty concerning the equality of hunger motivation requires us to exercise due caution in interpreting small differences in group performances. For instance, a small difference should not, without other substantiating evidence, be attributed to differences in the hereditary backgrounds of the animals in question, since previous experience leads us to expect significant group differences in maze performances even though only slight differences in motivation exist (Stone, 1929).

ANIMALS

All groups of this experiment had been given 10 trials (1 per day) on the stovepipe experiment. Also, all except 20 of the albino group Aa and all of group B had received the 10-day rating tests (see page 15). Thus, handling sufficed to reduce the factors of wildness and savageness in all of the groups, and restricted feeding in connection with the stovepipe experiment laid an excellent foundation for strong hunger motivation while they were on the maze.

LEARNING SCORES

Time and error scores have been recorded for each animal. An error consists of any entrance into a blind alley (see Figure 7), whether the animal is oriented toward the goal or backward toward the starting-box. The last trial preceding 10 errorless runs is arbitrarily taken as the number of trials denoting maze-mastery.

EXPERIMENTAL RESULTS

ANIMALS NOT THOROUGHLY TAMED

Experiments with the trapped wild stock which had been handled irregularly during the previous 5 or 6 months clearly demonstrated their unfitness for maze-training, even though tested under a high degree of hunger motivation. Typically, the animals crouched alongside the alley walls, retreated into corners farthest from the experimenter, and held immobile postures for long periods of time. Although some of them eventually came around to get the food, it was done with such a degree of stealth and retracing that the results are wholly equivocal from the standpoint of indicating their learning rate or ability. The familiar exploratory tendency was never in evidence.

Little different from the trapped wild stock was group G, the wild stock reared in the laboratory and previously handled for 20 days. Their results have value only in so far as they show the inaptitude of such wild stock for a typical maze experiment. Perhaps, had they been systematically tamed from birth, this would not have been the case, as may be inferred from results of an experiment on wild rats performed in the psychological laboratories of Stanford University by Drs. Harry Harlow and W. R. Miles (in press). Their wild stock, systematically handled from infancy, gave quite satisfactory maze performances when tested at the age of from 2 to 3 months.

Half-breeds which had been subjected to only a small amount of preliminary taming gave results almost identical with those described above. Either they refused to run the maze at all or at best crept along stealthily through the alleys, ever ready to dart hither and thither upon the slightest movement of the experimenter. Following their first experience of being caught in the food box, they hesitated long before entering again. Obviously, these animals cannot be successfully employed in maze tests without more taming than one is accustomed to give to albinos of the Wistar stock. A few of the yellow-hoods, not systematically handled or tamed, displayed in similar manner this hiding and avoidance tendency to such an extent that their maze scores could not be used. There is no doubt but that within the yellow-hooded strain many more animals will be found possessing strong avoidance and hiding tendencies than in the Wistar albinos.

ANIMALS SYSTEMATICALLY TAMED

As stated above, group G, which has the systematic taming associated with the rating and stovepipe experiments, refused to run the maze, with few exceptions; hence, their results are of no value for the group comparison we shall make below. All other groups having training similar to that of group G were successfully trained on the maze. Their results may be compared on the basis of trials to learn, error scores, and time scores.

FOR THE LASHLEY MAZE

d Learning: 10 Consecutive Errorless Trials)

Group	Mean, Trials	Sigma, Trials	Mean, Errors	Sigma, Errors
A, albino $N = 37$	13.74 ± 1.10	6.52 ± .78	38.03 ± 2.64	22.85 ± 1.87
B, yellow-hooded $N = 28$	14.32 ± .88	6.48 ± .62	44.68 ± 2.46	18.19 ± 1.73
C, yellow-hooded $N = 18$	11.70 ± 1.12	6.75 ± .78	34.41 ± 2.72	16.67 ± 1.93
J, quarter-breeds $N = 30$	9.39 ± .43	4.24 ± .30	27.93 ± 1.30	11.82 ± .92
D, half-breeds $N = 37$	8.90 ± .73	5.84 ± .52	23.55 ± .91	7.26 ± .64
E, half-breeds $N = 25$	8.46 ± .76	4.33 ± .53	21.66 ± 1.58	9.05 ± 1.21
F, half-breeds $N = 18$	10.39 ± 1.07	6.50 ± .75	33.22 ± 5.81	35.52 ± 4.11

TRIALS TO LEARN

Table 18 gives the means and the standard deviations of the distributions of trials to learn, according to our criterion of mastery. As will be seen, the albinos and the yellow-hoods required more trials than the quarter-breeds and the half-breeds. The albinos were likewise much more variable than either of the other groups. Data on the significance of differences between the means and standard deviations are given in Table 19. It may be seen that differences between groups A, B, and C are very unreliable.

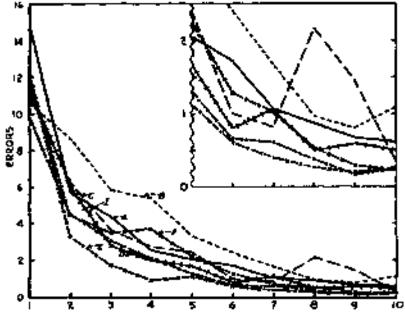
SIGNIFICANCE OF DIFFERENCES BETWEEN MEANS AND STANDARD DEVIATIONS OF THE NUMBER OF TRIALS REQUIRED TO SATISFY THE CRITERION OF LEARNING*

Group	Difference of Means	$\frac{D}{P.E._{diff.}}$	Difference of Standard Deviations	$\frac{D}{P.E._{diff.}}$
A vs. B	†0.58	0.41	3.04	3.04
A vs. C	2.04	1.51	2.77	2.57
A vs. I	4.55	3.68	5.28	6.28
A vs. D	4.84	3.67	6.45	6.86
A vs. E	5.77	3.93	4.49	5.57
A vs. F	3.15	2.06	3.02	2.86
B vs. C	2.62	1.85	†0.27	0.27
B vs. I	4.95	5.03	2.24	3.24
B vs. D	5.42	4.75	0.64	0.70
B vs. E	5.85	5.04	2.15	2.62
B vs. F	3.73	2.70	†0.02	0.02
C vs. I	2.51	1.94	2.51	2.98
C vs. D	2.80	2.11	0.91	0.97
C vs. E	3.23	2.30	2.42	2.57
C vs. F	1.11	0.72	0.25	0.23
I vs. D	0.49	0.50	†1.60	2.06
I vs. E	0.92	1.05	†0.00	0.01
I vs. F	†1.20	1.04	†2.26	2.79
D vs. E	0.43	0.41	1.51	2.04
D vs. F	†1.69	1.31	†0.66	0.73
E vs. F	†2.12	1.65	†2.37	2.36

* dagger (†) … an of the first group is the smaller, contrary t…
trend of diffe…

Likewise, those between the yellow-hooded group C, and the quarter-breed I, and the half-breeds D, E, and F are unreliable. But the means of albino group A and yellow-hoods B differ significantly from the means of the quarter-breeds and the half-breeds D and E. As to standard deviations, only group A differs significantly from the majority of the other groups.

Of special interest is the similarity of results for the blind group, F, and the normal groups, D and E. In this, as in other recent experiments supervised by the author, blindness gives rise to little handicap to the majority of the group (cf. Weaver and Stone, 1928, and Lindley, 1930). The group score is not significantly inferior to that of the normal groups.



ERROR CURVES

Figure 8 illustrates the mean number of errors made by each group on the first 10 trials. Although all animals were run more than 10 trials before satisfying the criterion of learning, their mean-error curves are so similar thereafter that nothing is gained by graphing them. In the upper right-hand corner of the figure the last half of the curve was repeated on a larger scale, in order that an exact plotting of individual graphs could be made.

The surprising feature of these results is the excellent performances of the half-breeds. Strong hunger motivation and the taming effects of previous experiments have made these animals as tractable and educable as any other group we have employed on this maze. As might be expected, group E, which was in a more acute state of chronic inanition than either of the others, made more rapid progress during the early trials than either of the others. Group B, which was not handled in the rating experiment but which was fondled in the home cage, is of particular interest also. Its performance was inferior to that of the others, just as it was inferior to the others in the concealment experiment. This appears to result primarily from the inferior records of a few animals which retraced a great deal and hesitated in coming around to the food box. In our opinion, these animals knew the maze very well after the first 2 or 3 trials but were reluctant to enter the food box where eventually they would be caught. With a more acute degree of hunger, probably they would have cut down their mean score to the level of the other yellow-hoods, group C. The mean curve of group F (blind) is somewhat higher than that of the other half-breeds on trials 3, 4, and 5. This is due to the exceptionally poor record of one animal (a total of 24, 33, and 18 errors on trials 3, 4, and 5, respectively). Yet, as a matter of fact, the mean number of errors of this group does not differ significantly from that of D or E.

Figure 9 illustrates the mean scores of the quarter-breeds distributed as to coat color. The differences are small and are probably at all points of the curves insignificant. Albinos of group I, in contrast with those of group A, do approximately as well as do either of the half-breed groups. This evidence may be taken as supporting the hypothesis that group A, the Wistar albinos, was not sufficiently motivated to bring out its true ability. Adequate proof of this hypothesis, however, is lacking. In Table 18 will be found the mean numbers of errors and the standard deviations of the error scores for each group. Here, as usual, there is a fair degree of correlation between total error scores and the trials to learn. For the half-breeds this correlation coefficient (Pearson) is 0.655 ± 0.06.

Table 20 indicates what differences between group means are statistically significant. Groups A, B, and C differ significantly from the quarter-breeds I, and the half-breeds D and E. Also, group E is significantly different from I. As to standard deviations of the distributions, it may be noted that groups A, B, and C differ significantly from the half-breeds D and E, but not significantly among themselves.

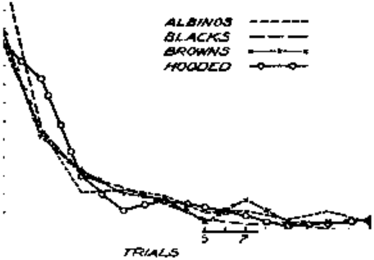


FIG. 9.—M [illegible] or scores of the quarter-breeds distributed as to c

So far as we can determine, our knowledge concerning the factors underlying the foregoing small differences in total errors is inadequate to account satisfactorily for them. One may say that the groups are too small for rigid statistical analyses of the reliability of differences; that motivation may have varied from group to group, since at best our methods of keeping this factor constant are still only rule-of-thumb procedures; that wild strains or their near relatives may actually possess greater native learning ability; and that the balance of conflicting motives in albinos, half-breeds, and what nots, may leave a substantial difference in the net effective motivation for maze-learning. Which, if either, of these suppositions is responsible for the differences obtained cannot be determined from the information at hand.

TABLE 20

Significance of the Differences between Means and Standard

Figure 10 shows the time curves of the various groups. For the most part, differences are relatively small; yet certain ones are deserving of comment. Group B contained some animals which, because of their timidity, hesitated to enter the food box; hence, the group mean was particularly high on certain trials. The same was true for group C and F on trials 3–6, inclusive. Although the animals apparently knew the correct pathway to the goal as well as the others, they refused to enter the food box, where they might be captured by the experimenter. A high degree of hunger motivation should overcome this factor to a marked degree, but the degree required varies with particular animals. In this series of experiments our full-wild animals proved to be so intractable that

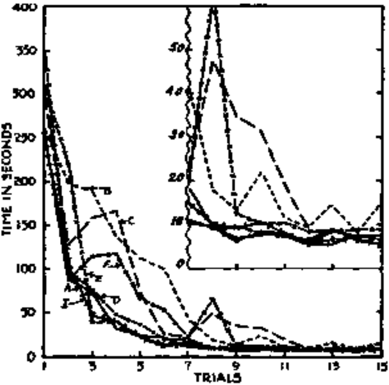


FIG. 10.—Mean-time scores of each group on trials 1–15 (all animals contributing to the mean of each group).

their results had to be discarded because they were too incomparable with either of the other groups herein studied. Of particular interest is the low level of time scores reached by the blind group, F. After the sixth trial their mean time score was so similar to that of the best of the others that in Figure 10 the eye cannot separate it from them.

As shown by Figure 11, the quarter-breeds exhibited no marked dissimilarily in time scores during the first 15 trials.

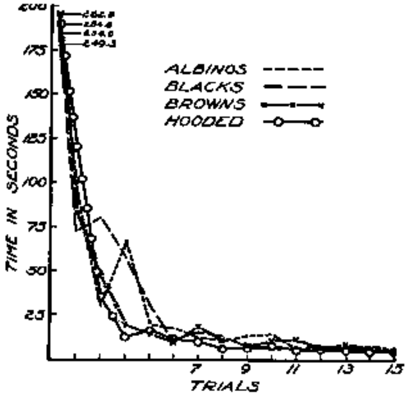


FIG. 11.—Mean-time scores of the quarter-breeds distributed as to coat colors

SUMMARY OF RESULTS FOR THE MAZE

1. Trapped wild rats that had been handled irregularly for approximately 6 months could not be induced to run the maze for the usual food reward. Likewise, wild stock bred in the laboratory and previously handled for 20 days were temperamentally unsuited to the typical maze-learning problem when tested at the age of 4 months. Earlier or more prolonged taming probably would have overcome their conflicting tendencies.

2. Half-breeds, quarter-breeds, and yellow-hoods, 4 months of age and previously handled for 20 days, performed on the maze in a manner quite equal to that of the Wistar albinos.

3. Half-breeds and quarter-breeds mastered the maze in somewhat fewer trials and with fewer errors than the albinos and yellow-hooded groups, whose previous pertinent experience was similar to their own. No adequate explanation of this result could be given.

4. The maze performances of quarter-breeds was very similar, irrespective of coat color.

5. Blindness proved to be no handicap to maze-learning in one group of half-breeds as compared with a normal group. Their records surpass those of the albinos and yellow-hoods.

6. Although timidity and wildness in rats may give equivocal learning data if not overcome by taming, the results of this experiment suggest that these tendencies may be sufficiently allayed by systematic handling and strong hunger motivation to insure against failure of obtaining a degree of persistence and effort in genetically wild and timid rats quite comparable to that obtainable from domesticated albinos.

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REACTION TENDENCIES RELATING TO PERSONALITY

A PHYSIOLOGICAL STUDY OF ANTICIPATION, EXCITABILITY, RECUPERATION, ADAPTATION, CONDITIONING, EXTINCTION, AND INHIBITION IN RELATION TO PERSONALITY DIFFERENCES

By CHESTER W. DARROW *and* LENA L. HEATH

INTRODUCTION

THE PROBLEM

The attempt to find logical order in the confusing field of personality differences has resulted in innumerable more or less conflicting classifications and systems. These are so many and varied that it is hardly possible that they can all correspond to objective reality. Even the most objective attempts at ascertaining the "dimensions" or "types" of personality by the analysis of behavior data of various sorts leave us with a question as to how much the work has dealt with differences which were fundamental and how much with nonessentials. Even a mathematical factor analysis of a series of data covering as wide a range of human behavior as possible could give only trends, frequencies, and consistencies revealing a logical pattern, perhaps, but differentiating not at all as to which were the incidental and which the psychologically fundamental consistencies.

Efforts at the classification of personality according to physiological differences of various sorts have been numerous and well received. The feeling is too prevalent, however, that anything physiological must in some manner be fundamental—even when physiological systems disagree.

On the contrary, we are inclined to agree with those who emphasize the importance of the "functional" factors in human behavior and misbehavior, if by functional they mean those complexities which are beyond our present observation and analysis. Because a psychological trait is not physiologically measurable, therefore, we do not argue that it is unimportant. Nevertheless, we feel safe in the assurance that personality traits which are correlated with differences in physiological reaction *are not unimportant*. In the quest for fundamental personality differences from which will be eliminated the majority of the nonessentials we have, therefore, in this study, adopted the plan of selecting from the widely varied data, obtainable by the questionnaire method, those items which are correlated with measurable physiological differences, even though those differences are in many cases small.

By this use of physiological measurements we not only have a means of selecting at least some of the important personality differences revealable by the questionnaire, but the one method of testing may serve more or less as a criterion of the other. In the case of a high correlation between the two sets of results, this would assist in the determination of the validity of both by contributing to the better definition of those elusive personality differences which each of the tests attempts to measure. The results from one test procedure might, in such a case, be diagnostic or predictive of those from the other. The correlations between variables within the two sets of data may even be too low to be of diagnostic or predictive value, but, nevertheless, offer valuable clues, because of certain consistencies and interrelationships, as to possible factors or unifying principles common to the two types of measures. In the present chaotic and highly speculative state of personality investigation, any clues as to an objective and natural organization of psychophysiological factors may be worthy of consideration. In offering the results of the present investigation, it is such a suggestion of a natural and objective organization of physiological and temperamental variables, rather than the achievement of a new predictive or diagnostic tool, that constitutes the reason for presentation.

THE EXPERIMENTAL PROCEDURE

THE QUESTIONNAIRES

The questionnaires which were employed in this study were the Thurstone Neurotic Inventory (Thurstone and Thurstone, 1930) and the Northwestern University Introversion-Extroversion Test (Gilliland and Morgan, 1931). If we grant a fair degree of truthfulness and insight on the part of the examinees, these questionnaires afford information concerning a wide range of attitudes and reactions which may be significant in the characterization of that complex of human reaction tendencies called "personality." We shall, however, when we use the terms "neurotic" or "non-neurotic," and "introversion" or "extroversion," in this paper, imply only the fact that individuals made certain scores on the above mentioned questionnaires.

THE PHYSIOLOGICAL TESTS

The laboratory test we have employed was formulated for the purpose of eliciting behavior of psychological significance, such as anticipation or anxiety, relief, adaptation to repeated stimuli, summation of responses to repeated stimuli, conditioning to indifferent stimuli, and rate of extinction of the conditioned responses. These terms are, of course, only general designations of the kinds of physiological activity on which information was sought. The extent to which the experimental procedure was effective in eliciting the kinds of reactions here designated may best be testified by the data on the various measures presented in the following pages. We were interested both in the skeletal and the visceral reactions under these conditions.

A. THE PHYSIOLOGICAL RECORDS

The records of reaction from which the measurements of these variables were determined are illustrated by Figure 1, where are reproduced the more important parts of one of the photographic records showing markings of the indicators for *A*, the signal marker; *B*, blood pressure; *C*, arm movement; *D*, respiration; and *E*, the galvanic skin reflex. The vertical white lines are second marks. An additional index of the intensity and uniformity of the electrical stimuli was included in the records of subjects run in the latter part of the study.

B. THE STIMULI

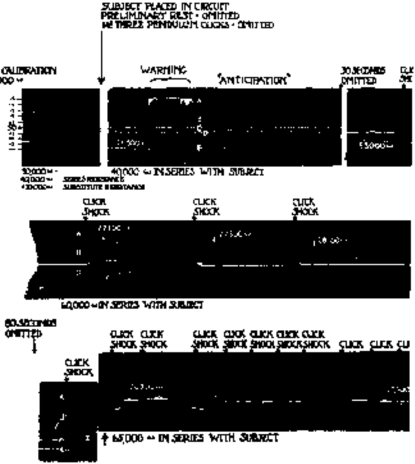
The stimuli employed in this study consisted of verbal warnings of the impending shocks, verbal information concerning periods of rest with no shocks, the clicks of the pendulum and pendulum release (part of the time governing the duration of the shocks), and a standardized electric shock acting on the flexor muscle of the thumb, *m. flexor pollicis brevis*.

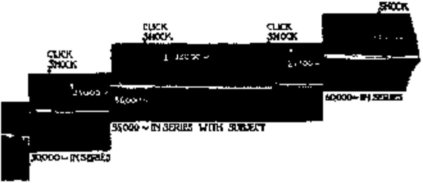
C. MOTOR STANDARDIZATION OF THE SHOCK

The electric shock, 0.1 second in duration, was adjusted to be either twice the strength of, or the same strength as, the 60-cycle tetanizing current required to draw the thumb toward apposition with the palm. By standardization of the shock in terms of this motor reaction of the subject, we attempted to obviate a difficulty arising from the fact that quantitatively equal electrical stimuli differ very greatly in effectiveness with different individuals. This is true whether the impressed voltage or the amount of current passing through the subject be the criterion. The utilization of the subject's own motor reaction for standardizing the strength of current was for the purpose of keeping the more immediate sensorimotor effects of stimulation constant, so that variations in the reactions under test conditions might with more assurance be attributed to psychological conditions.

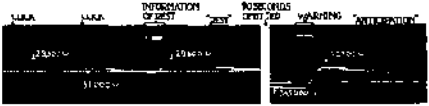
The strength of the tetanizing (faradic) current necessary to effect the flexion of the thumb to the critical point was not sufficient to be painful—in fact, the majority of the subjects were merely amused by the involuntary flexion of the member. The momentary shock of double intensity was judged by the majority of the subjects to be of about the same effectiveness as the continued stimulus of less strength. Although every subject was asked, immediately after the experiment, whether the shocks had been painful, no one reported this to be true. The word "dis-

RECORD SUBJECT 61

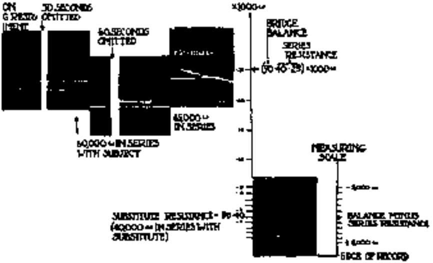




SHOCK
CLICK
SHOCK
CLICK
SHOCK
CLICK
SHOCK
60,000~ IN SERIES
35,000 ~ IN SERIES WITH SUBJECT
30,000 ~ IN SERIES



CLICK
CLICK
INFORMATION OF TEST
"TEST"
90 SECONDS OMITTED
WARNING
"ANTICIPATION"



ON G RESISTMENT
30 SECONDS OMITTED
60 SECONDS OMITTED
45,000 ~ IN SERIES
60,000 ~ IN SERIES WITH SUBJECT
31000~
BRIDGE BALANCE
SERIES RESISTANCE
(30·45·29) ×1000~
MEASURING SCALE
SUBSTITUTE RESISTANCE - 30·40
(40,000 ~ IN SERIES WITH SUBSTITUTE)
BALANCE MINUS SERIES RESISTANCE
EDGE OF RECORD

agreeable" was the term most commonly employed. The anticipation and attendant psychological conditions were generally described as more disagreeable than the actual shock. No significant differences appear in the average strengths of shock required by the "neurotic" and "non-neurotic" extremes of the Thurstone classification. The extroverts of the Northwestern University Test, however, required on the average somewhat more milliamperes current to produce the standard motor reaction than introverts. Data on this point and a detailed description of the apparatus and procedure governing the presentation of the electrical stimuli are given in the Appendix.[1]

The order of events comprising the test is essentially as follows:

1. The motor reaction of the subject is tested as follows:

The subject is informed that he will be tested for "muscular tonicity."

A large electrode, soaked in physiological saline solution, is wrapped above the right elbow; and a small (¼ inch in diameter), relatively non-polarizable electrode is held over the flexor muscle at the base of the thumb of the right hand. After the location of the motor point, the electrode is fastened in place by bandages and a padding of rubber sponge.

The tetanizing current is turned on and gradually increased in intensity by the adjustment of a potentiometer until the critical point in the flexion of the thumb, at which the subject may no longer voluntarily straighten it, has been attained. The process is repeated a few times until adaptation or practice effects have been largely eliminated, after which the amount of current indicated by a thermomilliammeter is recorded. By the adjustment of a standard non-inductive high resistance[2] which may be substituted for the subject, the apparent[3] A.C. resistance may be determined; and from the known resistance and the known amperage, the voltage may be calculated. With the substitute resistance in the circuit the milliamperage is doubled (this applies to groups I–II and the last series of group IV)[4] by adjusting the potentiometer. The substitute resistance is then thrown out of the circuit and the subject connected ready to receive the shock. The small electrode is fastened in place by means of bandages and a padding of rubber sponge.

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[1] Pp. 252–56.

[2] Due to delay in securing these standards, we have data on A.C. resistance and voltage available only in groups III–IV.

[3] Disregarding capacitative effects at the electrodes.

[4] See note 2, page 240.

2. The subject lies down and the recording devices are attached, as follows:

a) A rubber cuff is fastened around the biceps for registration of muscle reactions.

b) A pneumograph is placed around the chest for recording respiration.

c) The relatively constant-moisture, constant-pressure, constant-area, non-polarizing, non-irritating, electrodes are attached to the palm and back of the left hand for obtaining the records of the galvanic skin reflex.

d) A blood-pressure cuff is attached around the left ankle to give records of relative blood-pressure change (see method of reading blood-pressure change, page 260). The blood-pressure and arm-movement cuffs are inflated to the proper pressures.

3. (*a*) The subject's initial resistance is determined by a preliminary balancing of the bridge with sufficient resistance in series with him to allow for subsequent compensations without altering the balance of the bridge. (*b*) standard 1,000 ω, 5,000 ω, or 10,000 ω deflections under these conditions are imprinted upon the photographic record for use in later mensuration; (*c*) the apparatus is started, and the record of the subject is begun (see pages 256 ff.).

4. The instructions and stimulating conditions of the experiment are the following:

a) A buzzer is turned on.

b) (Included only in group I.) The subject is instructed to pull downward with maximal strength on a dynamometer. The reading is noted, and he is then instructed to hold the dynamometer at one-half this reading for 30 seconds.

c) The subject is instructed to relax, close his eyes, be as comfortable as he can, and go to sleep if possible. A blindfold is placed over his eyes. Two minutes of rest.

d) The click of the pendulum and pendulum release (non-conditioned stimulus) is given three times, followed each time by a 30-second interval.

e) The warning is given: "In a minute or two I am going to give you an electric shock. You can always tell when you may receive a shock by the fact that this buzzer is sounding." (The intensity of the buzzer is varied to call the subject's attention to the sound.)

f) A shock of double the standardized intensity is given seven times, with approximately 30-second[1] intervals between shocks. Each shock is immediately preceded by the sound of the pendulum release and accompanied by the click of the clockwork activating the pendulum.

g) The click of the pendulum and pendulum release without the shock is given three times with 30-second intervals after each.

h) The rest period is announced. The buzzer is turned off, and the subject is informed that the experiment requires that there shall be 2 or 3 minutes of rest with no stimuli, and that a warning will be given before further stimulation. Two minutes of rest.

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[1] Small variations from the standard intervals were frequently occasioned by necessity for adjustment of apparatus, etc.

Data on the remaining items (i to p) are not included in this report.

i) The warning is again given. The buzzer is turned on, and the subject is informed that more shocks will occur in a minute or two. Two minutes of anticipation.

j) The shocks are repeated; a series of seven, each followed by approximately a 5- or 7-second[1] interval.

k) The clicks of the pendulum are given: three pendulum clicks followed by 5-second[1] intervals.

l) The buzzer is turned off—the subject is informed that there will be 2 or 3 minutes of rest and that the experiment will then be over. Two minutes of rest.

m) The operator claps hands loudly.

n) The threat of drawing a blood sample and the actual drawing of blood for another purpose by Dr. N. W. Shock were carried out at this point.

o) Repeat electrical standards on the record (see 3*b*, page 64).

p) Release and question the subject concerning his experience.

THE SUBJECTS

This experiment has been performed using four groups of subjects. In three of our groups (groups I, III, and IV) these were Freshmen of the University of Chicago who had already filled out the Thurstone Neurotic Inventory. Their selection was determined solely by the possession of certain scores on the Thurstone questionnaire, their position in an alphabetical list, and their willingness to give time to our investigation. For group I we obtained A's and E's, the two extremes of the distribution of scores. For group II, run during the summer, we tried to secure high and low scores by taking a random sample of volunteers from the elementary psychology and mental-test classes. Only a few fell in the extreme ranges of A's and E's. For this and later groups the method of ranking was, therefore, used in the study of differences between individuals with high, medium, and low scores. In all the groups we tried to keep the number of men and women having high, medium, and low scores equal; but since this was not always possible, especially in the summer group, we shall give separate averages for men and women along with the treatment of the various measures. The Northwestern University Introversion-Extroversion Test data were obtained on groups II, III, and IV.

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[1] See note, preceding page.

PROCEDURE WITH DIFFERENT GROUPS OF SUBJECTS

Certain alterations in the experimental procedure appeared desirable as the data accumulated on the different groups of subjects quarter by quarter. The differences between the procedure with these groups are outlined in Table 1. The reasons for the changes are, briefly:

TABLE 1

CONDITIONS CHARACTERIZING VARIOUS GROUPS

Group	N	Time	Thurstone Ratings	Strength of Shock	Interval (Seconds)		General Reactions to—	
					First Series	Second Series	Thurstone Test	Gilliland Test
I	30	Spring 1930 (preliminary dynamometer)	A– E	2× standard	30	5*	E's more reactive than A's	No data
II.	21	Summer 1930	AB– BCD– DE	2× standard	30	7*	E's more reactive than A's	Extroverts more reactive than introverts
III	30	Autumn 1930	AB– C– DE	1× standard	30	7*	A's more reactive than E's	Extroverts more reactive than introverts
IV	Incomplete	Winter 1930–31	AB– C DE	1× standard (first series) 2× standard (second series)	30	30*	?	?

* Cf. note, page 64. Data B

1. The preliminary dynamometer test was abandoned after group I because it lowered the initial resistance of the subjects and thus interfered with the study of the relation of reaction and recovery to resistance level.

2. The interval between the shocks of the second series (data not here reported) was increased from 5 to 7 seconds in group II in order to permit better analysis of the curve of recovery following excitation.

3. The strength of the shock in groups I and II was set at double the standardized intensity because the single intensity was judged by the experimenters to be too weak to produce the desired effects. But double the standard intensity did not produce the uniformity in motor response which characterized the single intensity. Therefore, in group III the single intensity was employed. Group III, however, gave results which reversed some of our previous findings. Therefore, to determine if this reversal were a function of the strength of shock, in group IV (still uncompleted) we are giving the single intensity in the first series and the double intensity in the second series, 30-second intervals being used in both series.

4. The 30-second interval was employed for the second series of shocks (data not here reported) in group IV in order that the double intensity applied in this second series might be comparable in interval with the preceding single intensity shocks of the first series.

DIFFERENCES BETWEEN GROUP AVERAGES ON VARIOUS MEASURES

When the averages of the twenty-one measures employed in this study are compared from group to group, certain differences are found which may be classified as follows: (*a*) measurements on which the groups differ owing probably to changes in experimental procedure, (*b*) measurements on which groups differ owing probably to individual or seasonal differences, and (*c*) measurements on which groups do not appreciably differ. The averages of the reactions for the various groups and the probable significance of their differences are presented in the Appendix, pages 240 ff.

METHODS OF TREATING RESULTS

PROFILES OF REACTION

The general effect of the experimental procedure upon resistance is illustrated by the profiles of resistance changes occurring in subjects as represented in Figures 2 and 3. Resistance in ohms/1,000 is shown logarithmically on the ordinate, while the successive events which elicited these effects are noted on the abscissa. Reasons for using the logarithmic scale are presented on pages 256 ff. In such a profile the events designated on the abscissa do not, of course, represent equal time intervals. In Figures 2 and 3, respectively, are profiles from the five A's and the five E's, the two extremes of the Thurstone scale having the

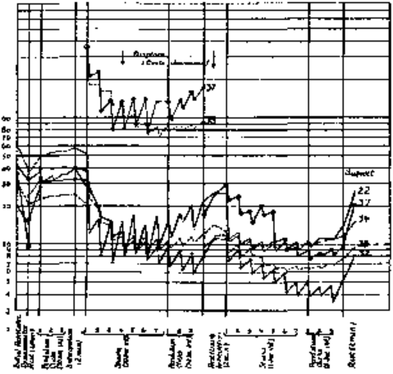

FIG. 2.—Profiles of A's ("non-neurotic" individuals) having the largest re

largest reactions; and in Figure 4 are the profiles of individuals with smaller reactions. In these profiles no differences in the reactions of the A's and E's are apparent by a cursory inspection.

PARALLELISM OF PROFILES FROM THE SAME SUBJECTS

By repetition and comparison of tests on the same person, we find a tendency for the shape of the profile to be characteristic of a given individual. Figure 4 gives instances of the parallelism between repetitions of the same test on the same subject on different days (one subject on the same day). It is generally true that, if there is a difference in the level of resistance on the two days, the resistance of the second day is higher than that on the first. Subject 30, Figure 4, was, however, slightly lower on the second than the first test. In one instance (subject 31, Fig. 4), where an individual was tested a second time on the same day but with the information preliminary to the second test that the shock would be of twice the first intensity, the shape of the profile was practically the same, but just prior to the shocks the level of resistance dropped to slightly below that of the first test. Thirteen out of 18 subjects from whom repetition records were obtained at a later date showed marked parallelism of the two days' records. The early phases of a study of the factors tending in some cases to

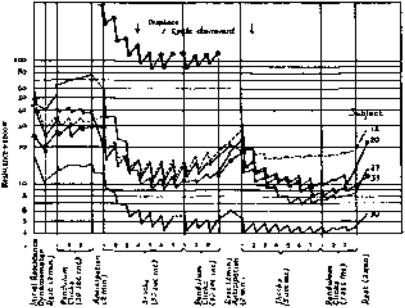

FIG. 3.—Profiles of E's ("neurotic" individuals) having the largest reactions

alter the shape of the profiles now promises to throw considerable light on the significance of the differences between individuals' reactions.

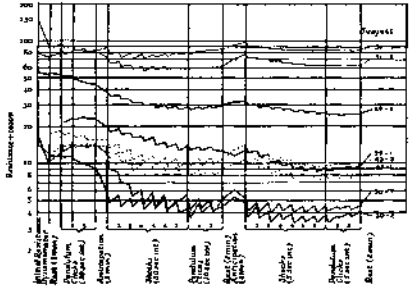

FIG. 4.— Profiles showing parallelism of records obtained by repetition of test on the same individuals. (These profiles illustrate the reactions of individuals having small- or moderate-sized reactions.)

COMPOSITE PROFILES OF REACTION

The course of other recorded events occurring along with the galvanic reaction is indicated in Figures 5 and 6. Here are shown in juxtaposition the pulse change, blood-pressure change, level of resistance, resistance change (per cent), and arm-movement reactions for each of the momentary stimuli: the clicks and the shocks. The position and size of the scale values for each of these measures is indicated on the ordinate by two sample values. The complete scale for each measure is readily inferred by interpolation and extrapolation. For instance, in the case of the blood-pressure reactions of subjects in Figure 5, the values,

Blood pressure 5 mm.
0 mm.

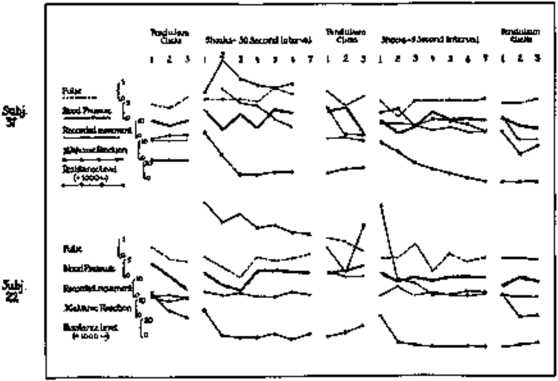

Fig. 5.—Composite profiles of reactions to momentary stimuli by two A's, subjects 37 and 22

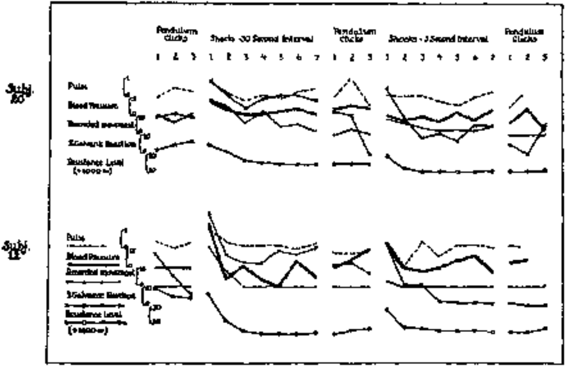

FIG. 6.—Composite profiles of reactions to momentary stimuli by two E's, subjects 10 and 11

are separated by one large-scale division (centimeters), and these values are in a given position on the ordinate. By extrapolation, one such scale division above 5 would equal 10 mm., and one such scale division below 0 would equal −5 mm. By the same process the complete scale for this or any of the other measures is readily inferred from the two values given.

From the composite graphs, better than from extensive tables or elaborate description, the complexity of the physiological patterns of reaction becomes apparent. While there are periods in the reaction of each subject when measures of two or more bodily activities show parallelism, and other periods when these same measures may appear to have a compensatory function, there is no law immediately evident governing the relationships. Here again, as in the case of the resistance change, a cursory inspection of the graphs does not reveal outstanding differences in the reaction patterns of the "neurotic" and "non-neurotic" subjects.

THE TABLES

To determine if there are relations between the various measures of physiological reaction and the scores on the two questionnaires, we have *ranked the subjects' total scores on the personality tests* for each of the groups; and for each group we have made three divisions having high, medium, and low scores, respectively. Where tables of these averages show for all groups consistent differences between the mean reactions of those making high, medium, and low scores, it may be considered an indication that the relationship merits further study. Where such tables do not show consistent relationships between the physiological data and the total personality scores, it may indicate (1) that the physiological changes have no relation to the personality items, (2) that the physiological record is not sufficiently precise, (3) that the subjects misreported the facts when answering the questionnaire, or (4) that significant relationships have been buried in the composite personality score.

THE HISTOGRAMS

To test the extent to which possibility (4) may have been operating in the case of each of the twenty-one physiological measures, we have *ranked the physiological data* from groups I and II (with double-strength shocks) and groups III and IV (with single-strength shocks in the first series), and divided groups I–II and III–IV, respectively, into five divisions having (1) minimum, (2) low-medium, (3) median, (4) high-medium, and (5) maximum scores. When the total N in each of the combined groups was not evenly divisible by 5, the odd cases were thrown into the median division or "quintile." The number of persons in each of these quintiles answering *yes*, *question*, or *no* to the specific questions of the personality inventory may then be represented by a histogram. We have adopted a form of histogram easily reproducible in type by the use of answer signs, where + = yes, ? = question or blank, and – = no. If both groups I–II and III–IV showed similar relationships between the physiological data and the answers to a given question, the data of the respective fifths were combined into a single histogram for presentation in this paper. That the reader may be able, if he so wishes, to separate groups I–II from groups III–IV, we have in each case followed the answer signs for the first groups by a period (.) and the answer signs for the second groups by a comma (,). The procedure is illustrated by an example taken from the study of the relation of the initial resistance of the subjects to the questions of the personality inventory.

Question: Have you ever had spells of dizziness?
4-15*

Groups	Initial Resistance	Answers
I–II	min. 1	
III–IV	min. 1	

---

he figures (4-15) represent, respectively, the column and question order in the [illegible] edition of the
of *Neurotic* [illegible]

Combining the respective fifths from these two groups with periods after the answer signs of groups I–II and commas after the answer signs of groups III–IV, we have

which shows that those having the minimum initial resistance also least frequently reported spells of dizziness.

It is often true that information herewith presented by means of histograms could be represented equally well by a correlation coefficient. On the other hand, important things such as the fact demonstrated in a histogram on page 81, that none of the individuals with low initial resistances are troubled with shooting pains in the head could not be represented by correlations. Because of a greater serviceability in the quest for clues to physiological-personality relationships, we have employed the space-consuming but more informative histograms.

All cases where both groups I–II and III–IV show any evidence of regression in the same direction are represented. Therefore, presentation of a histogram does not necessarily indicate that a significant relationship is assumed to exist. It is to be borne in mind that purely chance factors governing the mode of answering the questionnaire and the manner of reacting to stimulation (1) may cause correlation between items which have no actual relationship or (2) may conceal correlations between actually related variables. Since we have presented correlations only where regression appeared in the same direction in both groups I–II and III–IV, while we have not presented correlations where either groups I–II or III–IV failed to show regression, purely chance factors would be twice as likely to suppress a true relationship as to cause the presentation of a false correlation. This being the case, it is easily understood that one of two similar questions in the personality inventory may sometimes show a correlation and the other, not. The evidence must in all cases be weighed with respect to internal consistency, and with regard to agreement or disagreement with the observations of other investigators.

One test of internal consistency which we shall employ is that of correlation with composite scores on the personality items. By a method ("Composite Scores," p. 219) based primarily on certain inherent consistencies within the personality and physiological data, we have in the latter portion of this study compiled lists of items constituting "personality constellations." Barring the operation of purely chance factors governing the answers to the questionnaire, it is quite likely that if a person answers truthfully one of the questions within a constellation in a certain fashion he will also answer several others in a similar manner, and he will have a high composite score relative to some more general personality variable. Composite scores may serve, therefore, as a check on the consistency of answering questions. Correlations with the composite scores, therefore, will be considered of greater significance than relationships revealed by individual histograms. The interrelationships revealed by the natural groupings of the correlations between physiological measures and composite scores will be considered at length after discussing the significance of the twenty-one physiological measures.

EXPERIMENTAL DATA ON VARIOUS MEASURES

I. INITIAL RESISTANCE

Our reasons for using this measure are the possibilities, suggested by other studies, that initial resistance may provide an index of physiological status revealing something of the condition of the subject as he approaches the test and subsequently reacts to stimulation, and the fact that the magnitude of any reaction is, to no small extent, a function of the level of conductivity prevailing at the time. An adequate investigation of the electrical conditions of the skin may ignore neither the reactivity nor the resistance levels at which reaction occurs.[1]

There is, however, no consistent relation revealed in Table 2 between initial resistance and the scores on the neurotic inventory. While Table 3 suggests a slight tendency for "introverts," the individuals with low scores on the introversion-extroversion test, to have higher resistances than the "extroverts," the coefficient of correlation, r, of $-.079 \pm .087$ on the combined standard scores of groups II and III–IV shows that there is no significant relationship.

The following data were available from the university recorder's office: (1) American Council Intelligence Test scores, (2) the number of grade-points made during the first quarter, (3) the number of persons on probation because of scholastic deficiencies during the first quarter, and (4) the number of persons reporting membership in some fraternity or club. These were averaged for subjects in the respective quintiles of the initial-resistance scores, and we found no evidence that any of these data are related to initial resistance.

An examination of Table 4 shows that, as compared with the men, the women in groups I–II tended very definitely toward high, and in groups III–IV toward low, initial resistances. The combination of data from these two groups largely eliminates the possibility that the relationships here presented are due solely to sex differences. Why the initial resistance of groups I–II should range higher than in groups III–IV is not easily explained, unless further study should, as Cattell (1928) has suggested, reveal some factor such as a seasonal variation in skin resistance. Such a variation might possibly be a concomitant of variation in external temperatures or of alleged seasonal changes in general health.

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[1] See discussion of resistance level and relative resistance changes, pages 256–58 in the Appendix.

TABLE 2

THE RELATION OF INITIAL RESISTANCE (LEVEL OF RESISTANCE PRECEDING FIRST PENDULUM CLICK) TO NEUROTIC INVENTORY SCORES

This table shows no consistent relation between initial resistance and average scores on the neurotic inventory, although women with high "neurotic" scores tend to have the lower resistances.

Group	Total N	Sex	Low Scores (Non-Neurotic)			Medium Scores			High Scores (Neurotic)		
			N	Neurotic Inventory Score	Initial Resistance	N	Neurotic Inventory Score	Initial Resistance	N	Neurotic Inventory Score	Initial Resistance
I	[illegible]	M.	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]	[illegible]
		F.	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]	[illegible]
		M. and F.	[illegible]		[illegible]				[illegible]		[illegible]
					A.D. [illegible]						A.D. [illegible]
II	[illegible]	M.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		F.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		M. and F.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					A.D. [illegible]			A.D. [illegible]			A.D. [illegible]
III and IV	[illegible]	M.	6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		F.	6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		M. and F.	12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
					A.D. [illegible]			A.D. [illegible]			A.D. [illegible]

is too small to permit use of the standard deviation.

Although this measure shows no relationship to the total scores on either of the questionnaire tests, a study of the answers to the various questions of the personality inventory in their relation to

TABLE 3

THE RELATION OF INITIAL RESISTANCE (LEVEL OF RESISTANCE PRECEDING FIRST PENDULUM CLICK) TO INTROVERSION-EXTROVERSION SCORES

This table shows a slight tendancy for extroverts to have lower average resistances than introverts.

Group	Total N	Sex	Low Score (Introvert)			Medium Score			High Score (Extrovert)		
			N	Introversion-Extroversion Score	Resistance/1,000	N	Introversion-Extroversion Score	Resistance/1,000	N	Introversion-Extroversion Score	Resistance/1,000
II	21	M F	3 4	367 [illegible] 491	31.90 51.75	3 4	500 [illegible] 555	37.90 43.20	6 1	557 [illegible] 741	54.25 43.07
		M and F	7		39.97	7		40.95	7		46.16
					A.D. 12.30			A.D. 14.55			A.D. 12.27
III and IV	33	M F	7 3	484 [illegible] 507	31.60 23.50	7 3	500 60 551	25.07 24.27	5 6	550 [illegible] 605	20.19 22.58
		M and F	10		27.80	10		25.45	11		25.06
					A.D. 8.73			A.D. 5.08			A.D. 7.02

MISCELLANEOUS DATA ON INITIAL RESISTANCE

Group	Quintiles	N	Range (Resistance/1,000)	Sex (Percentage of Men)*
I-II	min. 1	10	6.8 to 11.0	90.00
	2	10	11.8 to 20.9	80.00
	3	10	21.5 to 32.9	60.00
	4	10	35.4 to 40.3	50.00
	max. 5	10	49.8 to 69.9	10.00
III-IV	min. 1	8	4.9 to 8.05	25.00
	2	8	9.0 to 10.9	62.50
	3	8	11.4 to 17.9	62.50
	4	8	18.0 to 21.5	37.50
	max. 5	8	22.5 to 49.0	75.00

* Indicates the percentage of the total N in each quintile who were males.

initial resistance may be profitable, providing we keep in mind that we are dealing with small differences and with an *N* limited to 90 cases. The correlations apparent in the histograms presented herewith suggest that certain conditions suggestive of ill health, such as the heart sounding in the ears and preventing sleep, spells of dizziness, talking in sleep, pains in the head, poor appetite, and constipation, are most frequently found among persons with high initial resistance.[1] The chances that a person having high resistance level will be found with any particular one of these conditions is small indeed; but if he suffers from one of these conditions, the probabilities are just slightly more than chance that his resistance will be high. These conditions of ill health are suggestive of a neurasthenic or hypochondriacal predisposition on the part of the subject, and all but two of the items are to be found in the list of twelve questions relative to "neurasthenic tendencies" listed on page 222. Resistance level gives a correlation with the frequency of "neurasthenic" answers by the various subjects of .113± .070. By Fisher's formula (Fisher, 1930, p. 150) the chances are 1 in 3 that such a correlation should occur by chance. Considered by itself, such a correlation is obviously too low to be of value; but in relation to other variables with which initial resistance and neurasthenic tendencies are related (Table 77), it may merit consideration.

In contrast to these observations for persons with high resistance is evidence that persons with low resistance may have a slight tendency toward depression and difficulty in their social relationships. They frequently report being self-conscious (vain?) of their personal appearance and being critical and contradictory of others. Their friends, they frequently report, have turned against them. These suggestively paranoid symptoms may possibly bear a relation to some sort of physiological hyper-irritability associated with low resistance (as in hyperthyroidism). Initial resistance correlates negatively ($r = -.211 \pm .068$) with scores on the fourteen paranoid items listed on pages 224-25. By Fisher's formula such a correlation would be likely to occur by chance 1 in 20 times.

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[1] Cattell (1928) has found certain evidences of ill health characterizing persons with extremely low resistance.

Questionnaire Items Relating to Initial Resistance

N = 90 (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank – = No

Questions Relative to General Health

Does your heart ever sound in your ears so that you cannot sleep? 1–9

Do you sometimes have shooting pains in your head? 7–2

u a good appetite? 8–1

max. 5 + + + + + + + + .+,+ ,+,+ ,+,+,+ ,? – . –,

Are you troubled much by constipation? 1–5

QUESTIONS RELATIVE TO SOCIAL RELATIONSHIPS

Do you often feel self-conscious about your personal appearance? 8–5

Do you think you are regarded as critical of other people? 8–13

Do you have the habit of contradicting people? 5–15

Have your friends ever turned against you? 6–4

3 + . ? . – – – – – – – – – –, –, –. –, –, –
4 + + + . ? – –. –. –. – – – –, –, –, –, –, –, –
max. 5 + + . +, –. – – . – – – –. – –, –, –. –. –, –

MISCELLANEOUS QUESTIONS

Are you frightened by lightning? 8–2
min. 1 – – – – – –. – – – –. –, –, –, –, –, –, –

QUESTIONS RELATIVE TO DEPRESSION

Do you often feel just miserable? 6–25

Do you often experience periods of loneliness? 7–17

min. 1 +.+.+.+,+,+,+,+,−.−.−.−.−.−.−.−,−,−,

max. 5 +.+.+,+,+,−,− −.−.−.−.−.−.−,−,−,−,−,

Additional evidence of a greater average reactivity on the part of persons with low resistances is found in Table 5, where a negative correlation is noted between initial resistance and the amount of recorded arm movement in both groups I–II and III–IV. This relationship is especially significant in groups III–IV, where there is a slight positive correlation between resistance level and the strength of the shock,[1] and where, therefore, the larger reactions cannot be attributed merely to greater strength of stimulation. This agrees with the numerous other indications that persons with low resistance tend to be somewhat above the average in responsiveness to excitation.

TABLE 5

THE CORRELATION OF INITIAL RESISTANCE WITH

Group	With Standardized Shock in Milliamperes	With Recorded Movement of Right Arm
I–II	−.381 ± .082	−.206 ± .092
III–IV	.112 ± .105	−.228 ± .105

The preceding suggestions of relationships are of interest in the light of the following findings of other investigators: Unusually high resistances of the backs of the hands were found by Richter (1926) to occur in some cases of catatonic stupor, while the palm-to-palm resistance in this condition might be abnormally low. He interprets this as indicating great nervous activity and subnormal muscular activity. He makes no statement regarding the effects of external stimuli on the galvanic responses of these patients. He reports (1928) that schizophrenics of a paranoid tendency show lower resistances than those who are more passive, and offers additional evidence (1929) that in narcoleptic and in stuporous, apparently schizophrenic, conditions the resistance, especially of the backs of the hands, is likely to be excessively high. Westburgh (1929) reports high resistances in catatonics and numerous cases of lower resistance in other forms of dementia praecox. Syz (1926) shows high resistances in catatonics, schizophrenics, and depressives. Cattell (1928), on the other hand, cites instances of poor physical conditions associated with low resistance. In harmony with Syz's and Richter's observations, Chevans (1926) found schizophrenics to have a greatly reduced cutaneous secretory activity. Petersen and Levinson (1930) report "nervous" men generally to have high resistances, save in exophthalmic goiter, where resistance was below average. They found negative correlations with metabolic rate and weight/height ratio. Vigouroux (1888) made observations similar to the foregoing regarding exophthalmic goiter. Golla (1921) experimentally reduced his own resistance and noted increased irritability following ingestion of thyroid extract.

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[1] Data on 60-cycle A.C. voltage and resistance through the stimulating electrodes on the right hand and arm are available only for 28 subjects of groups III–IV, owing to delay in getting suitable A.C. resistance standards. For these subjects there is a negative correlation of −.288 ± .119 between initial D.C. resistance of the left hand and A.C. resistance of the right. A near-zero correlation of .036 ± .130 appeared between the voltage of the standardized A.C. stimulus and the initial D.C. resistance of the left hand. For a summary of the studies on A.C. and D.C. resistance in relation to the phenomena of polarization, see Landis and De Wick (1929) and Landis (1932).

The canvass of our results on initial resistance reveals a slight, but (considered by itself) not significant, tendency for high resistance to be associated in "normal" individuals with certain "neurasthenic" tendencies, and for low resistance to be associated with certain "paranoid" tendencies. This, as far as it goes, is in agreement with evidence from the literature.

2. PER CENT GALVANIC REACTION TO THE NON-CONDITIONED[1] STIMULI

The per cent[2] galvanic reaction to the non-conditioned stimulus is calculated as follows:

$$\frac{\text{Ohms apparent resistance change after stimulus}}{\text{Ohms apparent resistance before stimulus}} \times 100 \text{ .}$$

After the initial 2-minute period of quiet the pendulum was released, which later in the test makes contacts for the electric shocks. This occurred three times with 30-second intervals between. The release mechanism and the clockwork actuating the pendulum produced a clicking sound which, after presentation with the shocks, became a conditioned stimulus and consistently elicited measurable physiological responses. When these clicks of the apparatus were sounded before any shocks had been associated with them, however, they might or might not produce physiological reactions in the subject. The presence or absence of reactions to these initial non-conditioned clicks, and the magnitude of the reactions when present, appear to a slight extent a function of certain personality traits, as may be gathered from the following analysis.

The scores for introversion-extroversion manifest, as is evident in Table 6, a slight tendency for the extroverts to give the larger reactions. On the combined data of groups II and III-IV we find the rather insignificant correlation, $r = .140 \pm .090$. Inasmuch as the introversion-extroversion score also shows correlations with the strength of the shock (p. 255), it is important that this correlation occurs with a measure which precedes the warning or administration of the electrical stimuli, for otherwise the larger responses of some subjects might be attributed to a greater strength of stimulation. The probability, P, that this correlation is the result of chance is 1 in 3.

The total scores on the neurotic inventory (Table 7) likewise show *no* consistent relation to the reactions following the non-conditioned stimuli. Nor do the composite scores (pp. 219 ff.), compiled from groups of similar items from the personality inventory, give greater than near zero coefficients of correlation with this measure. Furthermore, examination of the data from the recorder's office of the University of Chicago reveals no consistent relation between this measure and American Council Intelligence Test scores, grade-points for the first quarter, or the number of cases on probation for scholastic deficiencies; and for the sake of brevity the data are omitted. Only the proportion of persons reporting membership in some fraternity or club appears to vary somewhat in correlation. The percentage of individuals in the respective quintiles or quartiles[1] reporting fraternity or club membership varies somewhat with the magnitude of the non-conditioned reactions as shown in Table 8. In this table are also

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[1] "Non-conditioned" has appeared here preferable to "unconditioned" because of Pavlov's use of the term "unconditioned" to designate what we shall later refer to as the "conditioning" stimulus.

[2] The reasons for using "per cent change" instead of "absolute change" are presented in the Appendix, pp. 250 ff.

TABLE 6

REACTION TO N tioned Stimuli in Relation to Intr
Extroversion Scores

This table shows in both groups II and III–IV a tendency for react to the non-conditioned stimulus more than introverts.

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[1] Four rather than five divisions were used in the case of groups III–IV because this measure was one of the first treated in developing this method and because the

TABLE 7

NON-CONDITIONED GALVANIC REACTION IN RELATION TO NEUROTIC INVENTORY SCORES

This table shows no consistent relation between scores on the neurotic inventory and average reactions to the non-conditioned stimulus.

Group	Total N	Sex	Low Score (Non-neurotic)			Medium Score			High Score (Neurotic)		
			N	Neurotic Inventory Score	Average Per Cent Galvanic Reaction	N	Neurotic Inventory Score	Average Per Cent Galvanic Reaction	N	Neurotic Inventory Score	Average Per Cent Galvanic Reaction
I	36	M	10	4	2.50				9	75	5.05
		F	3	10	3.64				6	66	3.59
				14						106	
		M and F	13		2.30				15		4.49
					A.D. 2.19						A.D. 2.87
II	41	M	6	61	8.50	8	72	6.30	1	45	12.75
		F	1	56	9.60	5	60	8.96	5	90	9.60
				31			47			137	
		M and F	7		6.40	7		3.30	7		4.20
					A.D. 3.70			A.D. 4.69			A.D. 6.02
III and IV	40	M	6	5	3.00	6	59	1.33	8	74	5.09
		F	6	16	1.17	6	10	3.52	5	90	1.34
				52			53			129	
		M and F	12		3.09	12		5.51	11		2.53
					A.D. 2.07			A.D. 4.31			A.D. 7.14

ISIC REACTION TO THE

NON-CONDITIONED CL

Groups	Quintiles	N	Range (Per Cent Galvanic Reaction)	Sex (Percentage of Men)	Fraternity or Club Membership	
					Available N	Percentage
I–II. . . .	min. 1	10	0.0 to 0.6	40.00	8	37.50
	2	10	0.0 to 0.7	60.00	5	20.00
	3	10	0.7 to 2.4	70.00	5	60.00
	4	10	2.8 to 5.8	60.00	8	25.00
	max. 5	10	5.9 to 19.7	60.00	5	80.00
III–IV.	min. 1	10	0.0 to 0.9	40.00	10	10.00
	2	10	1.0 to 2.7	80.00	10	40.00
	3					
	4	10	3.0 to 4.8	50.00	9	22.20
	max. 5	10	5.0 to 10.5	70.00	10	30.00

shown the ranges of reaction represented by the various quartiles or quintiles, and the distribution of the sexes (the percentage of males) in each. There is a slight tendency for the men to be found with greatest frequency in the quintiles or quartiles representing the largest reactions. An examination of the relation of the non-conditioned reactions to the strength of the standardized shocks, and to the amount of recorded arm movement after stimulation, revealed no evidence of a relationship; and the data are therefore omitted.

The slight tendency already observed for the extroverts to give large reactions and for the introverts to give small reactions to these insignificant stimuli (clicks) may be of some importance in view of the fact that the Northwestern University Introversion-Extroversion Test was standardized by using manic depressives and schizophrenics as representatives, respectively, of the two extremes, extroversion and introversion. The findings of Travis (1922, 1924, 1925), that there is an increased auditory threshold for schizophrenic patients during crystal-gazing, are consistent with our results. Furthermore, Travis' psychoneurotics, who showed a decreased threshold during crystal-gazing, were characterized by an "external orientation" suggestive of extroversion, even though, by his classification, he did not include manic depressives in the group.

It is interesting, in the light of the correlation with the introversion-extroversion test and with club membership, that "introverted" or "shut-in" tendencies are shown in the answers to the neurotic inventory by persons having the least physiological response to the clicks. It is possibly to be expected, as appears in the histograms, that individuals who experience difficulty in finding their way about should be among those reacting least to the inconsequential sound of the apparatus. It is of interest, also, that those who are most concerned about their own internal conditions should be found among those who react least to this slight stimulus.

QUESTIONNAIRE ITEMS RELATING TO THE GALVANIC REACTION TO NON-CONDITIONED STIMULI

N = 90 (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank – = No

QUESTIONS RELATIVE TO SPATIAL ORIENTATION

Do you find your way about easily? 7–10

Do you easily learn to find your way about in new places?

Do you have great difficulty in finding your way around in the dark? 5–23

QUESTIONS RELATIVE TO HEALTH, POSSIBLY SHOWING NEURASTHENIC TENDENCIES

Can you stand disgusting smells? 5–21

min. 1 + + + +,+,+,? ? ?,?,?,–,– –,– –,–,–,–,–,

Does your heart sometimes sound in your ears so that you cannot sleep? 1–9

min. 1 + + + +,+,+,+,– – – – – – –,–,–,–,–,–,–,
2 +,+,?,–,– –,–,–,– – –,– –,–,–,–,–,–,–,–,

4 + +,? –
max. 5 +,?,?,–

Do you often have queer, unpleasant feelings in any part of your body? 7–31

min. 1 +, +, +, −. −. −. −. −. −. −. −. −. −, −, −, −, −, −, −, −,

5 ?, −, −. −, −. −, −. −. −, −
4 +, ?. −. −. −. −. −. −. −. −
max. 5 −. −, −, −, −, −, −, −, −, −

Questions Relative to Social Orientation

Are you careful not to hurt people's feelings? 2–3

max. 5 +. + +. + + + +. +. +. +. +, +, +. +. +, +. −, −, −,

Does it bother you to have people watch you at work? 4–31

4 +. +. +. + +, +, +, +, +, +, ?. ?, −. −. −. −. − −, −, −,
max. 5 + + +. +, +. +. +. −. −. − − −. − −. −, −, −, −, −.

Do you get tired of people quickly? 7–22

min. 1 + + + +, +, +, +, +. ?, −, −. − − − − −. −, −, −, −,
2 + + + + +, +, +. ?. ?. − − −. −. − −. −, −, −, −.
3 +. −. −. − −. − −. −. −. −.
4 +. +. +. +. +, +, +, ?, ?, − −. −. − −. −. −, −, −, −,
max. 5 + +, +, ?. −, − − − − −. − − −, −, −, −, −, −, −,

Do you frequently feel that you deserve a better lot than you have? 7–4

min. 1 +. + +. + +, +, ?. −. − − − − −, −, −, −, −, −, −, −,
2 +, +. +, ?. ?, ?, −. − −. −. −. −. −. −, −, −, −, −. −,
3 +. ?. ?. −. −. − −. −. −.
4 + +, +, ?, −. −. −, − − −, −. − −, −, −, −, −, −, −, −,
max. 5 +, ?. −. −. −. −. −. − − −, −. −, −, −, −, −, −, −, −,

Do you have difficulty in starting conversation with a stranger? 1–13

min. 1 + +. +, +, +, − − −. − −. −. − −. −, −, −, −, −, −, −,

QUESTIONS RELATIVE TO SOCIAL ORIENTATION—
CHILDHOOD—FAMILY SITUATION

Were you your parents' favorite child? 4–14
min. 1 ?,?,?,-.-.-.-.-.-.-.-.-.-.-,-,-,-,-,-,-,
2 +.+.?.?.?.?.?,?,?,?,?,-.- -,-,-,-,-,-,-,
3 +.+.+.+ +.?.?.-.-.-.
4 +.+.+.+ +,+,+,+,+,?.? -,- -.- -,-,-,-,-,
max. 5 +.+.+,+,?.?.?.?.?.?,?,?,?,?,?,?,-.-.-.-,

Is your mother dissatisfied with her lot in life? 6–20

We shall not mention other relationships suggested by the histograms which are presented for the reader's consideration. It may be sufficient to call attention to the fact that the suggestions of physiological differences already mentioned are of the same general character and in the same direction as those which have been frequently found associated with psychopathic conditions. Most significant for the results here reported are the observations on catatonic stupor. Peterson and Jung (1907), Ricksher and Jung (1907 8), Gregor and Gorn (1913), Syz (1926), Syz and Kinder (1928), and Westburgh (1929) have noted that the galvanic reflex in this condition tends to be weak or lacking. Wiersma (1915) observes that in those circumstances in which the patient is preoccupied with his own internal states there is little effect from additional external stimuli. Wells and Forbes (1908–11) likewise find a reduction in the size of reactions under these conditions. Prideaux (1920), furthermore, makes the generalization that most of the mental disorders have a subnormal galvanic reflex, the dements having the least, conversion hysterics having slightly greater, the anxiety hysterics having still greater, and normal individuals having the most reactivity. More recently, Ödegaard (1930) reports the greatest decrease in reactivity in the organic and schizophrenic psychoses, while the "neurotic" subjects and the "constitutionally abnormal" show more, and normals the greatest, reactivity. According to Westburgh (1929), paretics and then manic depressives rank next to normals in reaction. The tables presented by Abbot and Wells (1919) show some manic depressives with normal, and some with greater than normal, deflections. As partial exceptions to these observations is the fact that Peterson and Jung (1907) report normal reactivity in hebephrenics, and McCowan (1926) reports increased responses in this condition and in anxiety neuroses, while reactions were small in hysterics. Golla (1921) likewise observes small reactions in hysterics. Possibly accounting for these partial discrepancies is the suggestion of Prideaux (1920) that there is probably a greater reaction to ideational stimuli in anxiety neuroses and an accentuated reaction to sensory stimuli in conversion hysteria. It is of interest that Chevens (1926) obtained indication in the dementia praecox group of a marked delay in the activity of the sweat glands under standardized thermal stimulation. Assuming a high correlation between the electrical changes of the skin and changes in perspiration (Darrow, 1927), these differences in sweat secretion are in general agreement with the foregoing observation on the galvanic reaction.

On the whole, the galvanic reactions to the non-conditioned stimulus have given results which relate to the separate answers to the neurotic inventory in such a manner as to suggest "introverted" or "shut-in" tendencies on the part of persons with little or no reaction. The fact that no appreciable correlation appears with the scores on any of the constellations of questions from the neurotic inventory, however, leads one to question the reliability of the data from the histograms. On the other hand, a low positive correlation with introversion-extroversion scores confirms the view that extroverts ("normals" with a manic-depressive tendency?) are somewhat more reactive than introverts ("normals" with a tendency toward dementia praecox?) under these test conditions.

3. BLOOD-PRESSURE REACTIONS TO NON-CONDITIONED STIMULI

The blood-pressure reactions to the non-conditioned stimuli show, in Tables 9 and 10, no definite relation to scores on either the neurotic inventory or the introversion-extroversion tests. Answers to specific questions in the personality inventory, however, suggest that the larger increases in blood pressure are, to a slight degree, associated with previous nervous breakdown, enuresis, nightmares, and feelings of remorse. Numerous unsocial tendencies are found among the individuals having the larger blood-pressure reactions. This is just the reverse of what was observed for the galvanic reflex; and we find, when we select from our total number of cases the 14 individuals who have both the largest average blood-pressure rise and the smallest average galvanic reactions to the non-conditioned stimulus, that there is a slightly

RAGE BLOOD-PR E REACTION TO THREE NON-CONDITI
IN RE N TO NEUROTIC INVENTORY SCORES

e table shows n difference between the reaction

Grade	Total N	Sex	Low Score (Non-Neurotic)			Medium Score			High Score (Neurotic)		
			N	Neurotic Inventory Score	Average Blood-Pressure Reaction	N	Neurotic Inventory Score	Average Blood-Pressure Reaction	N	Neurotic Inventory Score	Average Blood-Pressure Reaction
[illegible]	48	M	29	[illegible]	0.30				7	18	0.65
		F	5	10	0.57				8	10	0.44
		M and F	43	14	0.45				15	106	0.43
					A.D. 0.31						A.D. 0.76
II	51	M	6	18	−0.32	2	35	−0.38	4	45	0.45
		F	1	40	−0.15	3	10	0.30	5	40	−0.87
		M and F	7	28	−0.14	5	42	0.09	9	417	−0.52
					A.D. 0.56			A.D. 0.75			A.D. 0.65
III and IV	15	M	6	4	−1.72	6	36	−0.42	7	75	0.09
		F	6	60	−1.37	5	40	−0.21	5	60	−0.84
		M and F	12	62	−1.55	11	53	−0.36	12	429	−0.31
					A.D. 0.19			A.D. 1.22			A.D. 0.49

higher frequency of certain unsocial tendencies in the resulting group.

This is shown by the replies to four of the questions made by four groups of 14 individuals each (Table 11). In these four groups are the individuals representing the most extreme cases of (1) small galvanic and small blood-pressure reactions, (2) small galvanic and large blood-pressure reactions, (3) large galvanic and small blood-pressure reactions, and (4) large galvanic and large blood-pressure reactions. Eight of each 14 individuals are from groups I–II, and 6 from groups III–IV. The reactions of the 14 individuals showing a predominance of unsocial tendencies have been indicated in the table by bold face figures. No other questions in the neurotic inventory showed differentiation of the replies made by persons having any of the four possible combinations of the two reactions.

TABLE 10

AVERAGE BLOOD-PRESSURE REACTION TO THREE NON-CONDITIONED CLICKS IN RELATION TO INTROVERSION-EXTROVERSION SCORES

This table shows no marked relation between introversion-extroversion score and blood pressure reactions to the non-conditioned pendulum clicks.

Groups	Total N	Sex	Low Score (Introvert)			Medium Score			High Score (Extrovert)		
			N	Introversion-Extroversion Score	Average Blood-Pressure Reaction	N	Introversion-Extroversion Score	Average Blood-Pressure Reaction	N	Introversion-Extroversion Score	Average Blood-Pressure Reaction
II	21	M. F.	3 4	361 to 401	−0.44 −0.09	3 4	500 to 553	0.07 −0.05	4 3	557 to 743	−0.10 0.34
		M. and F.	7		−0.25	7		−0.26	7		0.09
					A.D. 0.51			A.D. 2.04			A.D. 0.76
III and IV	34	M. F.	7 4	364 to 402	−0.33 −0.86	7 4	500 to 558	−0.06 −1.45	7 4	556 to 663	−0.06 0.35
		M. and F.	11		−0.70	11		−0.92	11		−0.43
					A.D. 0.63			A.D. 1.41			A.D. 0.68

There is a negative correlation of −.136±.094 in groups I–II

Personality Items Differentiated by Combined Blood-Pressure and Galvanic Reactions to Non-conditioned Stimuli

This table shows that individuals with the small galvanic and large blood-pressure reactions more frequently than others answer these questions in a "neurotic" manner. The answer, no (−), is considered a "neurotic"
question; the answer, yes (+), is the tic" answer to the other

	Small Galvanic Reactions						Large Galvanic Reactions				
	Small (−) Blood Pressure $N=14$			Large (+) Blood Pressure $N=14$			Small (−) Blood Pressure $N=14$			Large (+) B Pressure $N=14$	
	+	?	−	+	?	−	+	?	−	+	?
2-29 Do you take responsibility for introducing people at a party?	7	3	4	3	5	6	10	1	3	6	4
3-9 Are you frequently burdened by a sense of remorse?	2	1	11	7	2	5	3	1	10	6	1
4-31 Does it bother you to have people watch you at work even when you do it well?	5	2	7	9	1	4	5	1	8	7	0
7-13 Are you shy with girls?	1	1	12	6	2	7	2	0	12	1	1

ous Data on Blood-Pressure Reactio the Non-conditioned Clicks

Groups	Quintiles	N	Range (Average Blood-Pressure Reaction)	Sex (Percentage of Men)
I-II	min. 1	10	−1.37 to −0.57	50.00
	2	10	−0.33 to 0.00	50.00
	3	10	0.00 to 0.27	50.00
	4	10	0.27 to 0.60	70.00
	max. 5	10	0.73 to 4.17	50.00
III-IV	min. 1	9	−2.80 to −2.10	66.67
	2	9	−1.90 to −1.10	33.33
	3	5	−1.10 to −0.70	60.00
	4	9	−0.60 to −0.10	77.77
	max. 5	9	0.10 to 1.60	66.67

and of $-.198 \pm .101$ in groups III–IV between this measure and the strength of standard shock required to flex the thumb. In other words, the persons who gave the largest blood-pressure response to the clicks of the apparatus required, on the whole, slightly less electrical stimulus than others to produce equivalent motor reactions. There is no consistent relationship with the amount of recorded or rated arm movement. Men and women are found with about equal frequency in quintiles representing plus and in those representing minus blood-pressure reactions to the non-conditioned stimuli.

QUESTIONNAIRE ITEMS RELATING TO THE BLOOD-PRESSURE RISE AFTER NON-CONDITIONED STIMULI

N = 91 (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank – = No

QUESTIONS RELATIVE TO HEALTH, POSSIBLY SHOWING NEURASTHENIC TENDENCIES

Do you often have bad pains in any part of your body? 4–5
min. 1 +.+,+.– – – – –.–.– – –,+,–,–,–,–,–,–.

4 + +.+,– – –.– – – – –.–,–,–,–
max. 5 + + +,+,– – –.–.– – – – – –,–,–

Have you ever had spells of dizziness? 4–15

Do things ever swim or get misty before your eyes? 8–16

4 + +.+,+,+,?,–.– –,– – –.–.–,–,–,–,–,–,
max. 5 +.+.+.+.+,+,?.–.–. .–.–.–,–,–,–,–,–,

Do you consider yourself a rather nervous person? 2–9
min. 1 +.+,?.?,–.–.– –,–.–,–.–.–,–,–,–,–,–,–,

Do you feel tired most of the time? 5–22

QUESTIONS RELATIVE TO EMOTIONAL STABILITY

Are you frequently troubled with nightmares? 6–35

max. 5 ?,– –.–.–.–.–.– –.–.–.–,–,–,–.–,

Have you ever had a nervous breakdown? 2–13

3 + + ? – – – – – – – –.–,–.–,–.–,
4 – – . – – – – – – – – –,–,–.–,–,–,–,–,–
:. 5 ? – – – – – – – – – – –,–.–,–,–,–,–.–.–,

u were 5 years old have you ever had the habit of wetting the bed?

QUESTIONS RELATIVE TO SOCIAL ORIENTATION

Do you take responsibility for introducing people at a party? 1–10

max. 5 + + +.+ +,+,?.?.?,?,?,?,–.–.–.–.–,–,–,

Are you interested in meeting a lot of different kinds of people? 2–11

.+,?.?,–.

Do you keep in the background on social occasions? 3–2
min. 1 +,+,+,+,+,?,?,?,?,–,–,–,–,–,–,–,–,–,–,
2 +,+,+,?,?,?,?,–,–,–,–,–,–,–,–,–,–,–,–,
3 +,+,+,+,+,?,?,–,–,–,–,–,–,–,–,
4 +,+,+,+,+,+,+,+,+,?,?,–,–,–,–,–,–,–,–,
max. 5 +,+,+,+,+,+,+,+,+,+,?,–,–,–,–,–,–,–,–,

Do people think you are selfish? 3–11
min. 1 +,?,?,?,?,?,?,?,–,–,–,–,–,–,–,–,–,–,–,
2 +,?,?,?,?,?,?,?,?,–,–,–,–,–,–,–,–,–,–,
3 ?,?,?,?,–,–,–,–,–,–,–,–,–,–,
4 +,+,+,?,?,?,?,–,–,–,–,–,–,–,–,–,–,–,–,
max. 5 +,+,+,+,+,?,?,?,–,–,–,–,–,–,–,–,–,–,–,

Do you enjoy social gatherings just to be with people? 7–9
min. 1 +,+,+,+,+,+,+,+,+,+,+,+,+,?,–,–,–,–,–,
2 +,+,+,+,+,+,+,+,+,+,+,+,+,+,+,+,?,–,–,

max. 5 + + + +, ? – –
e you shy with girls? 7–11

max. 5 +,+,+,+,+,?,–,–,–,–,–,–,–,–,–,–,–,–,–,
Are you frequently burdened by a sense of remorse? 5–11
min. 1 +,+,?,–,–,–,–,–,–,–,–,–,–,–,–,–,–,–,–,
2 +,+,+,+,+,?,–,–,–,–,–,–,–,–,–,–,–,–,–,

4 +,+,+,+,+,+,+,+,+,?,–,–,–,–,–,–,–,–,–,
max. 5 +,+,+,+,+,+,?,?,–,–,–,–,–,–,–,–,–,–,–,

The averages of available data from the recorder's office at the University of Chicago for the respective quintiles of groups I–II and III–IV show no tendencies toward correlation of this measure with American Council Intelligence Test scores, with the number of grade-points made during the first quarter, with the number of cases on probation for scholastic deficiency, or with the number of persons having fraternity or club membership.

When the data on blood-pressure rise are correlated with composite scores on the questions (p. 221) indicating physical weakness, a correlation of .153 ± .070 is obtained. When correlated with the answers to the twenty-one questions regarding "socially inactive" tendencies (pp. 221–22), with the twelve questions relative to neurasthenic tendencies (p. 222), and with the questions on depression (p. 223), the resulting coefficients are respectively .162 ± .069, .164 ± .069, and .166 ± .069. The probability, *P* (Fisher, 1930), that any one of these correlations might have occurred by chance is 1 in 5. There was no evidence of a relationship to other composite personality scores. Coefficients of such low value as those given indicate, of course, no value of this measure for predictive or diagnostic purposes. They become of special interest only in view of the fact that there are other presumably independent physiological measures correlating in a similar and apparently systematic manner with these same composite personality scores (Table 77).

4. IMMEDIATE GALVANIC REACTION TO THE WARNING

The galvanic response to the warning, as evident in Table 13, shows no relation to the total neurotic inventory score; but, as in the case of the previously considered response to the non-conditioned stimuli, the extroverts of the Northwestern University Test give slightly larger average reactions. This difference, however, appears to have low reliability in view of the near-zero correlation[1] of .083 ± .090 with the combined standard scores for the introversion-extroversion data and the near-zero correlation of −.049 ± .071 with the composite score on "socially inactive tendencies" (list, pp. 221–22) in the neurotic inventory. Evidence from the histograms, that persons with the smaller reactions frequently report not meeting important persons at a tea, and absence of compunction about disposing of a salesman, must, under the circumstances, also be attributed to chance.

On the other hand, the fact that, among the persons with the larger galvanic reactions to the warning, the histograms reveal more than the average number of reports of emotional disturbance, such as uneasiness in a tunnel, blushing, and self-consciousness in the presence of superiors, is of slightly greater interest in

[1] The elimination of one case changes this correlation to .166 ± .089.

view of the correlation of .128 ± .070 with the composite scores on the frequency of reported anxieties (list, pp. 223–24). The probability, *P*, is 1 in 4 that this correlation is the result of chance. Of course, this is of no value for predictive purposes but is of interest in conjunction with other relationships to be presented. An exception to be noted to the general drift of the histograms is the fact that slightly more than the average number of those with small reactions report inability to stand the sight of blood.

LVANIC REACTION TO WA
NEUROTIC INVENTORY SCORES

This table shows a consistent difference between the reactions of pers high and low scores o the neurotic inventory.

Group	Total N	Sex	Low Score (Non-neurotic) N	Low Score (Non-neurotic) Neurotic Inventory Score	Low Score (Non-neurotic) Per Cent Galvanic Reaction	Medium Score N	Medium Score Neurotic Inventory Score	Medium Score Per Cent Galvanic Reaction	High Score (Neurotic) N	High Score (Neurotic) Neurotic Inventory Score	High Score (Neurotic) Per Cent Galvanic Reaction
I	[illegible]	M. F.	9 5	5 60	6.32 5.62				6 8	78 111	21.86 12.46
		M. and F.	14	14	6.10				14	106	12.38
					A.D. 4.80						A.D. 5.01
II	20	M. F.	6 1	11 60	10.42 4.90	2 5	75 90	5.15 11.90	2 4	45 111	11.75 5.43
		M. and F.	7	21	10.00	7	41	10.31	6	107	9.51
					A.D. 3.14			A.D. 11.54			A.D. 6.14
III and IV	36	M. F.	6 6	5 56	19.38 16.28	6 6	80 60	18.41 12.37	5 5	75 60	10.47 5.36
		M. and F.	12	31	19.98	12	13	15.35	12	109	8.43
					A.D. 7.01			A.D. 11.47			A.D. 7.08

This measure also gives a correlation of −.176 ± .069 with "somasthenic tendencies," the probability, *P*, that this is due to chance being 1 in 10. This is in agreement with other data indicating a tendency for persons with the larger galvanic reactions to be slightly above average in physical health.

TABLE 14

IM: C REAC O WAR N RELA
INTROVERSION-EXTROVERSION SCORES

This table shows larger average reaction by extroverts than by introverts.

QUESTIONNAIRE ITEMS RELATING TO THE IMMEDIATE
GALVANIC REACTION TO WARNING

$N = 90$ (.) = Groups I–II (.) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank – = No

QUESTIONS RELATIVE TO HEALTH

Do you ever feel an awful pressure in or about the head? 3–9
min. 1 +,+ +,+,?,- - - -,- -,- - - -,-,-,-,-,-,

Do you find necessary to watch your health carefully? 3–34

Did you ever have heart trouble? 4–30

min. 1 +.+.+.+.+,+,?,–.–,–.–.–

Questions Relative to Social Orientation

Do you find it difficult to get rid of a salesman? 1–12

max. 5 +.+.+.+.+.+,+,+,+,?.–.–.–.–.–,–,–,

Is your mother dissatisfied with her lot in life? 6–20

2 +.+.?.?,–.–
3 +.+,?.–.–.–
4 +,?.?.–.–.–
max. 5 +.?.?,?,–.–

At a reception or tea do you seek to meet the important person present? 6–23

min. 1 +.+,+,+,?,?.?.–.–,–.–.–.–.–,–,–,–,–,–,

3 +.+.+.+.+,+,?.?.?,?,–.–,–,–,
4 +.+.+,+,+,+,?.?.?,?,?,–.–.–.–.
max. 5 +.+.+.+.+.+.+,+,+,+,?,?,–.–.–

Questions Relative to Emotion

Does it make you uneasy to go into a tunnel or subway? 3–23

he sight of blood? 6–14

Are you bothered much by blushing? 6–17
min. 1 +,+.+,+,+,?.–.–.–.–.–.–.–.–,–,–,–,–,–,

Do you often feel self-conscious in the presence of your superiors? 7–31
min. 1 +.+.+ +.+,+,+,–.–,–.–.–.–.–,–.–,–,–,–,
2 +.+.+.+ +,+,+,+,?.–,–.–.–.–.–,–,–,–,–,

max. 5 +.+.+.+,+.+,+,+,+,+,+,+,–.–,–.–,–,–

MISCELLANEOUS QUESTIONS

Do you get tired of amusements quickly? 3–26
min. 1 +.+.+ +.+,+,+,+,+,?.–.–.–.–.–.–,–,–
2 +.+.+ +,+,+,+,+,?.?,–.–.–.–.–.–.–,–
3 + +.+,+,?.?,?,–,– –,–.–,–,–,
4 +.+.+.+,?,?,–.–.–.–.–.–.–,–,–,–,–,–
max. 5

There is a tendency in groups III–IV for the men to show larger galvanic reactions than the women. Since, however, this tendency is scarcely noticeable in groups I–II, and since only correlations involving both groups I–II and III–IV are presented in the histograms, it seems likely that sex is not the determining factor in the relationships that have been thus considered.

TABLE 15

Groups	Quintiles	N	Range (Percentage of Reaction)	Sex (Percentage of Men)
I–II	min. 1	10	0.0 to 4.6	50.00
	2	10	4.9 to 5.0	50.00
	3	7	5.8 to 9.9	57.14
	4	10	10.3 to 15.7	60.00
	max. 5	10	17.4 to 32.3	50.00
III–IV	min. 1	9	0.0 to 2.9	44.44
	2	9	4.7 to 9.5	55.55
	3	7	10.0 to 14.1	28.57
	4	9	17.1 to 21.6	77.77
	max. 5	9	26.0 to 40.9	77.77

Examination of the averages for the respective quintiles of groups I–II and III–IV reveals no evidence of a correlation of this measure with the American Council Intelligence Test scores, with the number of grade-points made during the first quarter, with the number of persons on probation for scholastic deficiencies, or with the number of individuals reporting membership in a fraternity or club.

By a similar examination of the averages for the respective quintiles, no consistent relation appears between this measure and the average strength of shock required to flex the thumb or the amount of recorded arm movement elicited under stimulation.

We may conclude from these data that the immediate galvanic reaction to the warning is, by itself, of but minor significance for the study of personality, there being a slight, and, considered by itself, not very significant, tendency for persons having various forms of anxiety and good general health to show the larger reactions.

5. IMMEDIATE BLOOD-PRESSURE CHANGE AFTER WARNING

Just as in the case of the galvanic reaction to the warning, the data (Tables 16 and 17) show no difference between the blood-pressure changes of persons with high and low scores on the neurotic inventory, but indicate somewhat greater responses by extroverts than by introverts, the correlation with introversion-extroversion scores for data from combined groups II and III–IV being .296 ± .093. For this correlation the probability, *P*, is 1 in 20 that it is the result of the operation of chance factors. As in the case of the non-conditioned stimuli, this relationship is of special significance because it precedes the administration of the shocks, and therefore is probably not to be attributed to the greater average strength of the stimuli given the extroverts. The magnitude of the blood-pressure rise after the verbal warning, just as was true of the galvanic reactions, is much greater than after the non-conditioned stimuli.

The fact, however, that the blood-pressure rise also tends to be much greater after warning than after the electric shocks (to be presented later, pp. 128 ff.), while the galvanic reaction, as stated in the preceding section, is considerably smaller than in the case of the shocks (pp. 121 ff.), suggests a differential blood-pressure and galvanic reaction to ideational as compared with sensory stimuli (see pp. 237 ff.), such as was previously found

IMMEDIATE BLOOD-PRESSURE REACTION TO WARNING IN RELATION TO NEUROTIC INVENTORY SCORES

This table shows no consistent difference between the reactions of "neurotic" and "non-neurotic" subjects.

Group	Total N	Sex	Low Score (Non-Neurotic)			Medium Score			High Score (Neurotic)		
			N	Neurotic Inventory Score	Average Blood-Pressure Reaction	N	Neurotic Inventory Score	Average Blood-Pressure Reaction	N	Neurotic Inventory Score	Average Blood-Pressure Reaction
I	29	M.	10	3	1.52				8	72	5.00
		F.	5	19	1.36				6	105	2.69
				12						100	
		M. and F.	15		1.47				14		3.98
					A.D. 1.55						A.D. 3.77
II	20	M.	5	11	2.04	2	33	3.00	2	45	4.36
		F.	1	20	1.96	5	70	6.80	5	30	2.32
				31			42			127	
		M. and F.	6		2.14	7		7.87	7		2.07
					A.D. 1.04			A.D. 4.14			A.D. 1.04
III and IV	30	M.	6	5	1.33	6	16	2.28	3	75	1.37
		F.	6	10	0.37	6	50	2.80	3	90	−0.84
				33			53			149	
		M. and F.	12		2.05	12		1.55	6		0.45
					A.D. 2.38			A.D. 1.60			A.D. 2.09

in another group of subjects. That "disturbing ideational" stimuli show a greater tendency to excite cardiac activity than to arouse peripheral reactions, such as the galvanic reflex, is a fact which seems to be borne out by the previously reviewed work of many investigators (Darrow [3], 1929).

There is evident in Table 18 a very slight tendency for the men to show larger blood-pressure reactions than the women. We may not safely speculate as to whether sex differences have contributed to the relationships considered in this section.

IMMEDIATE BLOOD-PRESSURE REACTION TO WARNING IN RELATION TO INTROVERSION-EXTROVERSION SCORES

This table shows a tendency for extroverts to give larger positive blood-pressure reactions to the warning than the introverts.

Group	Total N	Sex	Low Score (Introvert)			Medium Score			High Score (Extrovert)		
			N	Introversion-Extroversion Score	Average Blood-Pressure Reaction	N	Introversion-Extroversion Score	Average Blood-Pressure Reaction	N	Introversion-Extroversion Score	Average Blood-Pressure Reaction
II	20	M.	3	382	0.67	3	500	1.65	3	537	2.40
		F.	4	to	−0.98	4	to	4.08	3	to	6.51
		M. and F.	7	495	−0.37	7	535	3.36	6	542	4.37
					A.D. 2.70			A.D. 1.77			A.D. 3.25
III and IV	33	M.	7	384	0.56	5	504	1.41	5	556	1.98
		F.	5	to	1.10	6	to	−0.44	5	to	4.87
		M. and F.	12	501	0.90	11	550	0.78	11	605	1.92
					A.D. 0.87			A.D. 1.64			A.D. 2.13

MISCELLANEOUS DATA IN RELATION TO IMMEDIATE BLOOD-PRESSURE CHANGE AFTER WARNING

Groups	Quintiles	N	Range (Average Blood-Pressure Reaction)	Sex (Percentage of Men)
I–II	min. 1	10	−8.0 to 0.0	50.00
	2	10	0.0 to 1.5	50.00
	3	8	1.6 to 2.0	62.50
	4	10	2.0 to 3.0	40.00
	max. 5	10	3.0 to 14.0	60.00
III–IV	min. 1	9	−8.0 to −1.0	55.55
	2	9	0.0 to 0.6	66.67
	3	7	0.6 to 1.9	42.86
	4	9	1.9 to 2.3	55.55
	max. 5	9	2.6 to 5.6	77.78

There is no evidence from examination of the averages for the respective quintiles that this measure bears any relationship to the American Council Intelligence Test scores, to the number of grade-points made during the first quarter, to the number of individuals on probation, or to the number of persons reporting membership in a fraternity or a club.

Examination of the averages for the respective quintiles showed no relation between this measure and the strength of the standardized shock or the amount of arm movement elicited thereby.

A study of the answers to the questionnaire most frequently given by persons with the larger blood-pressure rise after warning suggests that this group is often oversensitive regarding matters affecting the integrity and security of the "self." At least this hypothesis offers the nearest approach to an explanation of diverse aspects of the subject's behavior by a unitary principle. The fact that there is no appreciable correlation with any of the groups of items represented by our composite personality scores (pp. 219 ff.) makes us hesitant in attempting to find meaning in these apparently conflicting results. Nevertheless, the concepts of mental "conflict," "resistance," and "blocking," possibly the products of conscious or unconscious fear, that have frequently been employed to account for the blood-pressure and reaction-time disturbances characterizing deception, are possibly applicable to this wide diversity of situations.

Questionnaire Items Relating to the Immediate Blood-Pressure Reaction to Warning

$N=91$ (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank − = No

Questions Relative to Ideational Processes

Are you frequently burdened by a sense of remorse? 3–11

min. 1 +.+,−.−.−.−,−,−.−.−.−,−,−,−,−,−,−.−.
2 + +.+,+,?,−,− −.−.−.−.−.−.−,−,−,−.−,−,
3 +,+,+.+,+,?,−.−.−.−.−.−,−,−,−,
4 +.+.+.+.+,?.?,−.−.−.−.−.−,−,−,−,−,−,−,
max. 5 +.+.+.+.+,+,+,+.? ?,−.−.−,−,− −,−,−,−,

Does your mind ever wander badly so that you lose track of what you a doing? 5–15

Do things often go wrong for you by no fault of your own? 6–21

Do you often find that you cannot make up your mind until the time for decision has passed? 8–10
min. 1 + +.+,?.?,–.– – – – + –.–.+,–.–,–,–.–,

Are you slow in making decisions? 8–21

4 +.+.+ + +.+.+,+.? ? ?,?,– – –.– –,–,–,
max. 5 + +.+ + + + +,+,+,+,? ? ?,?,?,– – –,–,

Do you think you know yourself well from having observed your own mind? 6–22
min. 1 +.+.+.+.+ + +.+ +,+,+,+,+,+,+,?.?.?,?,

Questions Relative to Social Orientation

As a child did you like to play alone? 1–1
min. 1 +.+.+,+,+,?,?,–.– –.– – –.+.+.–,–,–,–,
2 +.+,+,– –,–.– –.– –.–.–.–,–,–,–,–,–,
3 +,+,?,–.–.–.–.–.–.–.–.–,–,–,–,–,
4 +.+.+,+,+,+,+,–.– –.– –.–.–.–,–,–,–,–,
max. 5 +.+.+.+.+.+.+,+,+,+,+,+,?.?,–.–.–.–,–,–,

Do you often feel that you do not get your chance in social conversation?

max. 5 +,+,+,+,+,+,+,+,–,–,– –,–,–,–,–,–,

e you sometimes a leader at a social affair? 2–4

max. 5 +,+ + + +,+ +,+,+,+,+,+,?,?,?,–,–,–,–

Do you hesitate to volunteer in a class recitation? 7–1

max. 5 +,+,? ?,– – · · , , ·,·,–,–

Do you ever take the lead to enliven a dull party? 7–10

We may say of the immediate blood-pressure response to the warning that there is a tendency for a group of "extroverts" to give higher average blood-pressure reactions than a group of "introverts." The difference is not, however, sufficiently reliable to be of predictive value in individual cases. There are other interesting differences in the manner in which persons with large and small changes answer the questions, differences about which we may speculate, but the reliability of which we may only question.

6. PER CENT RESISTANCE CHANGE IN TWO MINUTES FOLLOWING THE WARNING[1]

Those data are calculated in the same way as the immediate reaction to the clicks, e.g.:

$$\frac{\text{Resistance change during 2 minutes after warning}}{\text{Resistance before warning}} \times 100 .$$

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[1] Including the immediate reaction.

Since excitation normally produces a decrease in the apparent resistance of the skin, this test was formulated with the expectation that changes in resistance following the warning of the shocks should give us a measure of the excitation due to apprehension or anxiety. Of course it must be borne in mind that such changes are only relative to what has gone before; and if the subject was already in a state of excessive apprehension, we might expect the additional effect from this warning to be small. This may account for the near-zero correlation with the composite score on anxiety. It is true, however, that the answers to certain items in the personality inventory show interesting relationships, and these will be offered by histograms for the reader's evaluation.

TABLE 19

PER CENT RESISTANCE CHANGE IN 2 MINUTES FOLLOWING FIRST WARNING IN RELATION TO NEUROTIC INVENTORY SCORES

This table shows no consistent relation between scores on the neurotic inventory and average resistance change following warning of impending shocks.

Low Score	[illegible] Score	
	Inventory Score · Per Cent Resistance Change	[illegible]

Contrary to our expectation, there appears no consistent relation between this measure and the total score on the neurotic inventory. In the case of the Northwestern University Introversion-Extroversion Test, however, the "extroverts," as in the case of the immediate reaction to the warning, showed in both groups I-II and III-IV a slight tendency toward large effects of the warning (the *r* on the combined groups is .183 ± .088), perhaps revealing, by this physiological evidence of apprehension, their alertness to the conditions of their environment. The probability that this is the result of chance is 1 in 5.

PER CENT RESISTANCE CHANGE IN FIRST WARNING
IN RELATION TO INTROVERSION-EXTROVERSION SCORES

This table shows that in groups II and III-IV the extroverts tended to have larger average decrease in resistance than the introverts.

Per Cent Resistance Change

Table 21 shows that both in groups I-II and III-IV there is a predominance of women in the class intervals containing the minimum of anticipatory reaction. Whether our results for reaction to the warning are attributable in any degree to what we might infer them to indicate (e.g., infrequent anxiety states, a high incidence of poor health, or neurasthenic tendencies among women), we may not safely answer.

Data for the respective quintiles on average American Council Intelligence Test scores, on grade-points for the first quarter, on the number of persons on probation for scholastic deficiency, and on the number of individuals reporting fraternity or club membership, show no evidence of a correlation with the resistance drop after the warning; and these are, therefore, omitted.

TABLE 21

Miscellaneous Data on Resistance Drop during 2 Minutes after Warning of First Shocks

Groups	Quintiles	N	Range (Per Cent Galvanic Reaction)	Sex (Percentage of Men)
I–II	min. 1	10	8.8 to − 0.5	30.00
	2	10	− 1.2 to − 5.9	60.00
	3	8	− 6.1 to −12.9	62.50
	4	10	−14.1 to −25.0	70.00
	max. 5	10	−25.0 to −42.0	50.00
III–IV	min. 1	9	11.4 to − 4.8	33.33
	2	9	− 5.0 to −12.8	66.67
	3	7	−13.7 to −22.7	42.86
	4	9	−23.7 to −35.5	77.77
	max. 5	9	−37.9 to −61.2	77.77

No relation appears between the respective quintiles of this measure and the average strength of the standard shock or the average arm movement elicited by the shocks.

The anxieties most frequently reported by the persons with maximum galvanic effects due to the warning, as indicated by the histograms, are fear of contracting disease, depression over low marks in school, thoughts of death, and fear of being followed in the dark. Because blushing seems frequently to be an evidence of social anxiety, we have included the answers relative thereto as an optional addition to the list.

The answers to the questions on social and spatial orientation which show relationship to this measure do not group themselves in a clear-cut manner, and we shall, therefore, leave them for the reader's own interpretation. Reports of the necessity to be careful of one's health, of previous heart trouble and anemia, and of preference for intellectual over athletic, and of indoor over outdoor, activities are made most frequently by persons with small change. The correlation with answers indicating "somasthenic" tendencies is $-.310 \pm .064$, the probability, P, being less than 1 in 100 that this correlation is due to chance. This is consistent with the other evidence that persons in a subnormal physiological condition tend to have small galvanic reactions (see pp. 126 ff. and 233 ff.)

Questionnaire Items Relating to the Per Cent Resistance Drop during 2 Minutes after Warning

$N = 91$ (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes (?) = Question or Blank – = No

Questions Relative to Anxiety—Apprehensiveness

Are you often afraid of contracting disease? 5–25

Have you ever been depressed because of low marks in school? 5–29

max. 5 +.+ +.+.+,+,?,?,–.–.–.–.–.–.–

Are you troubled by thoughts of death? 6–2

At night are you frequently troubled by the idea that somebody is following you? 7–25

max. 5 + +.+

Possibly also:

Are you bothered much by blushing? 6–27

min. 1 +.+.+,+,?,-.-.-.-.-.-.-.-.-

3 +.+
4 +.+.+.+,+,+,+,-.-.-.-.-
5 +.+.+ +,+,+,+,+,?.?.?,-

QUESTIONS RELATIVE TO GENERAL HEALTH

Do you find it necessary to watch your health carefully? 5–34

Did you ever have heart trouble? 4–30

min. 1 +.+.+.+,?,-.-.-.-.-.-.-

Do you prefer participation in competitive intellectual amusements to athletic games? 5–26

min. 1 +.+ +.+.+.+ +,+,+,+,+,+,?.?.?,?,-.-.-,
2 +.+ +.+,+.+,+,?.?.?,?,-.-,-.-,-,-,-,-,
3 +.+.+.+,+,+,?.-.-.-.-.-,-,-,-,
4 +.+.+.+,+,+,?.-.-.-.-.-.-.-,-,-,-,-,-,
max. 5 +.+ +,?.?.?,?,?,- -.-.-.-.-.-,-,-,-,-,

Would you rather work indoors than outdoors? 7–23

2 + +.+,?.?.? ?,?,?,-
3 +.+.+,+,?,-.-,-.- -
4 +.+.+,+,+,?.?.-.-.-
max. 5 +.+.+.?,?,?,?,-.-.-

Did you ever have anemia badly? 8–6

2 ?,-.-.-.-.-.-.
3 ?.?.-,-,-,-,-
4 + ?,-,-,-,-.-.
max. 5 +.?.- -.-.-.-

Questions Relative to Social Orientation

Do you often feel lonesome, even when you are with other people? 2–7

min. 1 +,+,+,+,+,+,+,+,+,+,?,?,?,–,–,–,–,–,–,
2 +,+,+ +,+,+,+,? ?,?,–,–,–,–,–,–,–,–,

max. 5 +,+,?,–,–,– –,–,–,–,–,–,–,–,–,–,–,–,–,

Do you think you are regarded as critical of other people? 8–13

Questions Relative to Spatial Orientation

Do you find your way about easily? 7–10

We may infer from these data on resistance change during 2 minutes after warning that this measure, like other measures of galvanic reaction to stimulation, bears its chief relationship to items on general health. To a less extent it appears positively related to the scores on introversion-extroversion.

7. SPONTANEOUS GALVANIC REACTIONS[1] DURING TWO MINUTES OF ANTICIPATION OF THE SHOCKS

This measure is calculated as follows:

$$\frac{\text{Summation}^{1} \text{ resistance decrease in } \omega \text{ for all spontaneous reactions during 2 minutes of anticipation}}{\text{Resistance in } \omega \text{ before warning}} \times 100 .$$

One of the striking characteristics of the records of certain subjects is the frequency of the galvanic deflections without apparent relation to any known stimulus. These spontaneous reactions ordinarily occur with greatest frequency during periods which for some reason might be characterized by mental tension or anxiety, as, for instance, during the period of anticipation of the electric shocks here under consideration. Yet, strangely enough, the individuals with the largest and most frequent spontaneous reactions do not in this study report numerous conditions of anxiety, nor does Table 22 show that they give appreciably different scores from others on the neurotic inventory. Quite unexpectedly, these are the persons having, on the average, the best "physical vitality." Persons with an absence of spontaneous changes are most likely to be "physically inferior," to have to watch their health, and to have had indigestion, nightmares, anemia, and heart trouble.

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[1] The immediate galvanic reaction to the warning is not included in this summation.

TABLE 22

SPONTANEOUS GALVANIC REACTIONS DURING 2 MINUTES OF ANTICIPATION IN RELATION TO NEUROTIC INVENTORY SCORES

This table shows no consistent relation between spontaneous reactions and scores tory.

Group	Times N	Sex	Low Score (Non-neurotic)			Medium Score			High Score (Neurotic)		
			N	Neurotic Inventory Score	Per Cent Spontaneous Galvanic Reactions	N	Neurotic Inventory Score	Per Cent Spontaneous Galvanic Reactions	N	Neurotic Inventory Score	Per Cent Spontaneous Galvanic Reactions
I	[illegible]	M. F.	19 5	3 60 14	75.80 22.50				6 8	72 10 106	33.86 38.49
		M. and F.	25		67.62				14		36.23
					A.D. 25.40						A.D. 11.51
II	19	M. F.	5 1	11 16 31	54.98 25.00	2 9	83 90 44	48.55 17.89	1 4	45 100 117	38.37 24.05
		M. and F.	6		19.99	3		46.65	6		21.54
					A.D. 13.63			A.D. 24.12			A.D. 13.96
III and IV	[illegible]	M. F.	6 6	5 56 11	40.70 19.96	6 6	86 60 33	35.44 33.01	7 3	75 50 119	26.25 18.06
		M. and F.	11		40.15	12		34.68	11		19.82
					A.D. 18.45			A.D. 17.34			A.D. 11.68

The correlation, *r*, of galvanic change with the composite scores for items indicating poor general health ("somasthenic" tendencies) is $-.235 \pm .067$. The probability, *P*, that this correlation is a result of chance is less than 1 in 20. A correlation of $-.172 \pm .070$ is also found with the frequency of answers indicating sleep difficulties ($P = .1$). As might be inferred from Table 22, no marked correlation ($-.112 \pm .074$) is found with total scores on the neurotic inventory.

c REACTIONS DURING 2 MINUTES OF ANTICIPATION TO INTROVERSION-EXTROVERSION SCORES

This table shows a tendency for extroverts to give more spontaneous reaction than introverts.

Group	Total N	Sex	Low Score (Introvert)			Middle Score			High Score (Extrovert)		
			N	Introversion-Extroversion Score	Per Cent Spontaneous Galvanic Reactions	N	Introversion-Extroversion Score	Per Cent Spontaneous Galvanic Reactions	N	Introversion-Extroversion Score	Per Cent Spontaneous Galvanic Reactions
II	19	M.	2	.567	9.34	5	.509	71.69	4	.337	51.34
		F.	4	10	16.37	6	.90	86.14	3	.10	37.65
				.403			.551			.741	
		M. and F.	6		14.38	6		75.18	7		36.90
					A.D.			A.D.			A.D.
					10.23			6.33			27.52
III and IV	35	M.	7	.460	17.71	7	.609	47.01	5	.356	70.97
		F.	1	.10	10.70	4	.96	18.51	3	.10	40.79
				.507			.350			.665	
		M. and F.	12		17.06	11		37.11	12		30.39
					A.D.			A.D.			A.D.
					14.38			18.41			15.36

The persons with the smaller galvanic reactions may also encounter certain difficulties in their social relationships as indicated by the histograms. The reliability of these indications is, however, very low, as indicated by correlations with the composite scores on all items related to "socially inactive" or to "paranoid" tendencies (lists, pp. 221 and 224) of only $-.099 \pm .070$ and $-.034 \pm .071$, respectively. The correlation of resistance change during anticipation with scores on the extroversion-introversion test of .261

±.026 is, however, of somewhat greater significance. The probability, *P*, that this could have occurred by chance is 1 in 20.

Questionnaire Items Relating to the Spontaneous Galvanic Reactions During Two Minutes of Anticipation

N = 90 (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank − = No

Questions Relative to Health

Are you frequently bothered with indigestion? 3–6

3 −.−
4 +.−

Do you find it necessary to watch your health carefully? 3–34
min. 1 + + +.+ + +,+,+,− −,− −.− −,−,−,−,−.−,

Are you physically inferior to your associates? 6–6

Are you frequently troubled with nightmares? 6–33

Did you ever have heart trouble? 4–30
min. 1 +.+.+,?,−.−.−.−.−.−.−.−
2 +.+.+.+.+,+,−.−.−.−.−.−
3 +.+,?.?,−.−.−.−.−.−,−,−

Did you ever have anemia badly? 8–6

min. 1 + +,+,+,?,–.–.–.–.–,–,–,–,–,–,–,–,–,–,

3 +.?.–
4 +.?.–
c. 5 ?.?.–

Questions Relative to Social Orientation

Were your parents partial to any of your brothers and sisters? 4–6

max. 5 ? ?.? ?.?.?.?,?,–.– – –.–, ,–,–,–,–,–,

Is your mother dissatisfied with her lot in life? 6–20

min. 1 + + + +,+,?,?,?,?,– – – –.–.– –.–,–,–,
2 + + ? ?.– – – –.–.– – –,–,–,–,–,–,–,–,
3 +,? – – –. – – –,–.–,–,–,–,
4 + +.? ? – – – – – – – – –.–,–,–,–,–,–,–,
max. 5 + ? ?,?,–.– –.– – –.– – –,–,–,–,–,–,–,

Was your mother the dominant member of the family? 7–28

Are you shy with girls?

Is there anyone you want to get even with? 4–20

Do you think most people are *self-seeking* or *malicious*? 1–11
min. 1 +,+,+,+,+,+,?,?,–,–,–,–,–,–,–,–,–,–,–,

Do you prefer participation in competitive intellectual amusement
letic games? 5–16

Questio lative to Emotion
make you uneasy to a bridge or a river? 4–21

max. 5 –,–,– –,–,–,–,–,–,–,–,–,–,–,–,–,–,–,–,–,

We note in Table 24 a very slight tendency for women to give less spontaneous reaction than men. We may not safely infer whether or not sex differences have contributed to the relationships of this measure with personality.

TABLE 24

Miscellaneous Data Relative to the Spontaneous Galvanic Reactions during 2 Minutes after Warning

Groups	Quintiles	N	Range (Per Cent Galvanic Reactions)	Sex (Percentage of Men)
I–II.	min. 1	10	0.00 to 5.68	30.00
	2	10	7.25 to 13.91	80.00
	3	7	14.00 to 22.58	71.43
	4	10	25.00 to 36.43	40.00
	max. 5	10	38.57 to 82.87	50.00
III–IV.	min. 1	9	1.20 to 11.74	55.56
	2	9	14.23 to 28.00	66.67
	3	7	29.00 to 34.13	57.14
	4	9	34.16 to 37.72	55.56
	max. 5	9	51.86 to 108.22	66.67

No clear and consistent relation appears between this measure and American Council Intelligence Test scores, the number of grade-points during the first quarter at the university, the number of cases on probation, or the number of fraternity or club memberships; and the data are not presented. The averages for the respective quintiles, likewise, show no relation to the strength of current in the ensuing shocks or to the amount of arm movement actually elicited thereby.

The significance here found for this measure is, in general, the same as that of other forms of galvanic reactivity—it appears to be somewhat related to general vitality and to "extroverted" tendencies. Since "extroversion" is symptomatic of manic depressive tendencies, according to the method used in standardizing the Northwestern University Test, our results are in accord with Ödegaard's (1930) report of a high frequency of "continuous" curves in manic cases. The significance of spontaneous reactions will be considered further in section 11, pages 142 ff., on the spontaneous galvanic reactions in the intervals between the electric shocks.

8. PER CENT GALVANIC REACTION TO ELECTRIC SHOCKS[1]

The size of the galvanic reactions (of the left hand) to the shocks, as shown in Table 25, is not a function of the strength in milliamperes of the alternating current shock (on the right hand)

CORRELATIONS BETWEEN PER CENT GALVANIC REACTION TO THE SHOCK AND CONDITIONS OF EXCITATION

Groups	Milliamperage of Standardized Shock	Voltage of Standardized Shock*	A.C. Resistance at Stimulating Electrodes*	Recorded Arm Movement
I-II.	−.021 ± .095	. . . .	. . . .	.112 ± .098
III-IV.	.065 ± .102	−.033 ± .127	.053 ± .127	.284 ± .099

* Data on A.C. voltage and resistance were not available in groups I-II, owing to delay in securing suitable non-inductive resistances.

or, according to the data available for groups III-IV, a function of the impressed A.C. voltage. There is, however, some evidence of a correlation of the galvanic reactions of the left hand with the recorded motor response to the shock elicited in the right arm.

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[1] Except as otherwise stated these data deal with reactions to the first three shocks.

Table 26 gives the ranges of reaction for the respective quintiles in groups I–II and III–IV. The percentage of men in the various subdivisions indicates that the women in groups I–II with the double-intensity shocks gave somewhat larger reactions than the men. It is quite possible that sex differences have been contributory to the results in this section.

TABLE 26

MISCELLANEOUS DATA RELATED TO REACTION III

No clear relation appeared between averages for these quintiles and data from the recorder's office on the American Research Council Intelligence Test scores, the grade-points during the first quarter, or the number of cases on probation for scholastic difficulties. Only the frequency of fraternity or club membership showed any relationship, the data being presented in Table 26.

A study of the galvanic reactions to the shocks in relation to the total score on the Thurstone Personality Inventory in Table 27 shows no consistent relationships.[1] Table 28 shows a tendency for the extroverts to manifest the larger electrical effects, the

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[1] The coefficient, r, for the combined data of groups I–II and III–IV is $-.125 \pm .072$. Crosland (1931) reports a correlation of $-.364$ ($N = 33$) between neurotic inventory scores and galvanic reactions to visual and verbal stimuli. For a smaller number ($N = 22$) he obtained a correlation of $-.421 \pm .124$ with reactions to phonographically presented stimulus words.

TABLE 27

PER CENT GALVANIC REACTION TO THE SHOCKS IN RELATION TO NEUROTIC INVENTORY SCORES

This table shows no consistent difference between the reactions of "neurotic" and "non-neurotic" subjects.

Group	Total N	Sex	Low Score (Non-neurotic)			Medium Score			High Score (Neurotic)		
			N	Neurotic Inventory Score	Per Cent Galvanic Reaction	N	Neurotic Inventory Score	Per Cent Galvanic Reaction	N	Neurotic Inventory Score	Per Cent Galvanic Reaction
Reaction to First Three Shocks											
I	30	M.	10	4	18.44				5	32	22.58
		F.	9	10	20.58				6	60	21.57
		M. and F.	19	22	19.60				11	106	21.60
					A.D. 10.22						A.D. 9.68
II	21	M.	6	21	20.75	2	33	27.35	3	45	32.65
		F.	1	60	14.80	5	80	20.33	4	80	18.41
		M. and F.	7	75	21.36	7	42	23.40	7	127	25.40
					A.D. 2.50			A.D. 7.44			A.D. 8.50
III and IV	36	M.	8	5	20.33	6	10	12.07	7	84	12.46
		F.	4	30	20.25	6	40	16.95	5	110	10.82
		M. and F.	12	87	19.84	12	81	15.01	12	239	11.70
					A.D. 4.80			A.D. 5.80			A.D. 8.80
Reaction to Second Three Shocks											
I	30	M.	10	4	13.00				9	81	21.88
		F.	5	40	21.56				6	90	16.42
		M. and F.	15	24	17.30				15	106	16.56
					A.D. 9.03						A.D. 6.35
II	21	M.	5	22	14.08	2	33	20.51	2	45	19.80
		F.	2	40	13.40	5	70	14.08	5	80	18.84
		M. and F.	7	72	13.80	7	42	18.80	7	127	16.20
					A.D. 3.03			A.D. 4.73			A.D. 7.76
III and IV	36	M.	6	5	17.04	6	10	11.18	7	75	12.57
		F.	6	40	17.56	6	40	19.45	5	80	9.46
		M. and F.	12	22	17.45	12	51	15.32	12	189	10.80
					A.D. 3.57			A.D. 4.90			A.D. 4.63

difference being chiefly noticeable in the case of the subjects of group II who received double-strength shocks. The correlation, *r*, on the combined data of groups II and III–IV is .139 ± .088 for the first three shocks. The galvanic reactions also correlated

TABLE 28

PER CENT GALVANIC REACTION TO THE SHOCKS IN RELATION TO INTROVERSION-EXTROVERSION SCORES

Group II shows a tendency, and group III–IV little tendency, for extroverts to give larger reactions to the shocks than introverts. Women in general show larger reactions than men.

Group	Total N	Sex	Low Score (Introvert) N	Low Score (Introvert) Introversion-Extroversion Score	Low Score (Introvert) Per Cent Galvanic Reaction	Medium Score N	Medium Score Introversion-Extroversion Score	Medium Score Per Cent Galvanic Reaction	High Score (Extrovert) N	High Score (Extrovert) Introversion-Extroversion Score	High Score (Extrovert) Per Cent Galvanic Reaction
					Reaction to First Three Shocks						
II	21	M.	3	367	10.07	3	509	26.90	4	557	18.58
		F.	4	40	15.05	4	40	23.38	3	60	33.07
		M. and F.	7	401	13.00	7	553	24.56	7	544	22.30
					A.D. 4.60			A.D. 8.43			A.D. 9.40
III and IV	35	M.	7	364	11.86	7	509	18.48	8	556	17.70
		F.	5	10	19.78	4	60	14.69	3	10	18.90
		M. and F.	12	507	14.70	11	551	16.80	12	665	15.60
					A.D. 8.85			A.D. 5.67			A.D. 5.40
					Reaction to Second Three Shocks						
II	21	M.	3	367	7.70	3	509	30.17	4	557	30.15
		F.	4	40	12.93	4	10	23.45	3	60	14.51
		M. and F.	7	403	10.70	7	352	25.40	7	744	22.00
					A.D. 2.30			A.D. 8.30			A.D. 8.09
III and IV	35	M.	7	364	12.90	7	509	18.21	5	556	8.96
		F.	5	40	15.80	4	10	34.68	7	60	37.27
		M. and F.	12	407	13.65	11	952	26.95	12	605	24.07
					A.D. 4.26			A.D. 9.84			A.D. 5.90

−.114±.069 with composite scores on "socially inactive" tendencies. The probability, *P*, in both cases is 1 in 3. Evidence that persons with large reactions are, more often than other persons, members of fraternities or clubs has already been mentioned (Table 26).

QUESTIONNAIRE ITEMS RELATING TO THE PER CENT GALVANIC REACTION TO FIRST THREE ELECTRIC SHOCKS

$N=93$ (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank − = No

QUESTIONS RELATIVE TO GENERAL HEALTH

Do you find it necessary to watch your health carefully? 3–34

max. 5 −.−,−.−.−,− − − −.− −,−:

Did you ever have anemia badly? 8–6

QUESTIONS RELATIVE TO EMOTIONAL STABILITY

Are you frequently troubled with nightmares? 6–33

Do you have a great fear of fire? 5–19 (The regression is in this instance confined to groups I–II. The data are given for reasons explained in the text.)

min. 1 +,?.−,−.−,−.−,−.−.−.−.−,−,−,−,−,−,−,−, An examination, by means of histograms, of answers to specific questions of the personality inventory shows the following relationships: None of the 19 subjects with maximum reactions reported having to watch his health carefully. Although only one of the 55 with the largest reactions had had anemia, there were 6 among the 38 having the smaller changes who had had an attack of anemia. Just as in the case of the reaction to the non-conditioned stimulus, and the reaction and anticipation after warning, there is some relation between abundant good health, as indicated by these items, and large resistance changes. The correlation here obtained between the size of the galvanic reaction and composite scores on answers to the neurotic inventory indicating poor health ("somasthenic" tendencies) is $-.160 \pm .068$, P being less than 1 in 5.

The relationship appearing in this and in some of the previously discussed measures between magnitude of the galvanic responses and the state of health reported by the subjects is presumably not attributable wholly to chance, since it has already been suggested in the work of several other investigators. For instance, W. S. Brown (1925–26) found a rather definite relation between the magnitude of the deflections and "soundness of constitution." The correlations he found with "desire to excel," "rapidity in decision," "persistence," and "bodily activity" also have bearing on this problem. Westburgh (1929) found in psychopathic patients a parallelism between galvanic reactivity and clinical ratings of health on different days. In this connection it is of interest that Cattell (1929) inferred large reactions to be indicative of "force of character." In an earlier report (1928) he had also signified a relation, among other things, to good physical condition and "good mental grip." Washburn (1925) obtained larger mean deflections of the galvanometer from subjects who were rated as "cheerful" than from those classed as "depressed." The evidence which has already been cited in our previous enumeration of certain physiological correlates of psychopathology (pp. 91 and 92) offers additional confirmation of the view that a healthy physiological reactivity is likely to be associated with large galvanic reactions. As previously stated, this generalization may possibly be further qualified when we have completed our study of the effects of varying the intensity of stimulation.

Since large galvanic reactions have frequently been assumed to be evidence of emotionality, we naturally looked for relations between the magnitude of the changes after these sensory stimuli and answers which would indicate emotion. The only suggestion of this kind in both groups I–II and III–IV occurred on the question regarding nightmares. Four of the 38 individuals with the largest galvanic reactions, and none of the others, reported this trouble. There was also a suggestion in the total data that persons with a fear of fire are likely to be among those with the largest electrical changes. This relationship, however, was only evident in groups I–II, but we have presented the material because of its bearing on the question of the galvanic reaction as an indicator of "emotionality." The failure to find a correlation in each of the groups between the magnitude of the reactions and the subjects' reports of their "emotionality" and the fact that the correlation with "excitability" for the combined data from groups I–II and III–IV is no higher than .103 ± .069, raises again the question of the value of the simple galvanic response to a sensory stimulus as an index of "emotion."

In the case of "ideational" stimuli the question whether the galvanic reflex is a reliable index of emotion becomes still greater, as shown by the reactions to various kinds of stimuli when another index of emotional disturbance (blood pressure) is also available (Darrow [2], 1929). Especially in psychopathic cases have we found instances where ideational stimuli, such as questions regarding the patient's specific conscious difficulty, occasioned excessive blood-pressure rise with little or no galvanic reaction, while other and non-emotional(?) stimuli given at the same sitting produced more nearly normal galvanic effects. The possibility that there is actually an "inhibition" of reaction under certain conditions will be considered in another connection (pp. 196–98 and 203). Landis (1929) reports instances in which crying, acute visceral pain, flushing, and sweating occurred without an accompanying galvanic response. We may cite the arguments as to whether the galvanic reflex is an index of emotion in the papers by Wechsler (1925), Bartlett (1927), and Landis (1930).

The elaboration of data on the per cent galvanic reaction to the electric shocks is but confirmatory of other evidence that large galvanic reactivity is to some extent related to general health and to "extroverted" (non-introverted) tendencies.

9. BLOOD-PRESSURE RISE (FALL) AFTER THE SHOCKS[1]

That the blood-pressure rise after the shocks shows a positive correlation with the strength of the shocks is shown in Table 29. There is also a positive correlation with the amount of arm movement and the magnitude of the galvanic reaction for the weaker shocks in groups III–IV, but none for the stronger shocks in groups I–II.

TABLE 29

CORRELATIONS BETWEEN BLOOD-PRESSURE RISE AND CONDITIONS OF EXCITATION

Groups	Milliamperage of Standardized Shock	Recorded Arm Movement	Per Cent Galvanic Reaction
I–II	.235 ± .091	.466 ± .100	.084 ± .097
III–IV	.171 ± .101	.246 ± .103	.130 ± .101

Table 30 gives the range of reaction represented by the respective quintiles of groups I–II and III–IV. On the whole, there is less tendency toward minus or small positive blood-pressure reactions in the case of groups I–II than in groups III–IV. This is possibly attributable to the lessened strength of the shocks employed with the latter groups. A comparison of the number of grade-points, the number of cases on probation during the first quarter, and the number of fraternity or club memberships in the respective quintiles showed no relation to this measure.

The average of the American Council Intelligence Test scores, however, was slightly higher for persons with the larger reactions, as indicated in Table 30 ($r = .097 \pm .122$ for groups I–II and $r = .293 \pm .096$ for groups III–IV). This table shows a slight tendency for the women to have more minus blood-pressure changes than the men.

TABLE 30

MISCELLANEOUS DATA RELATING TO BLOOD-PRESSURE RISE AFTER 1 OF FIRST THREE SHOCKS

Groups	Quintiles	N	Range (Average Blood-Pressure Reaction)	Sex (Percentage of Men)	American Council Intelligence Test Score
I–II	min. 1	10	−6.67 to −0.70	30.00	166.6
	2	10	0.17 to 0.67	70.00	201.2
	3	9	0.73 to 1.47	55.56	181.0
	4	10	1.63 to 2.70	50.00	189.6
	max. 5	10	2.73 to 5.87	70.00	201.3
III–IV	min. 1	9	−4.30 to −1.07	77.78	178.7
	2	9	−1.00 to −0.07	44.44	178.8
	3	7	0.07 to 0.53	42.86	183.6
	4	9	0.67 to 1.33	66.67	193.5
	max. 5	9	1.50 to 7.77	66.67	226.0

In Tables 31 and 32 it is evident that blood-pressure rise after the shocks shows no consistent relationship to the neurotic inventory scores ($r = -.120 \pm .073$), and but little evidence of a correlation with measures of introversion-extroversion, r on the combined data of groups II and III–IV being $.101 \pm .091$.

Subjects showing small or minus changes in blood pressure have a tendency to answer a large number of questions in a manner indicating some degree of ill health. In this measure, however, we find considerable suggestion that neurasthenic or hypochondriacal tendencies, rather than true physical debility, may account for the relationships. Replies indicating that the subject with small or minus blood-pressure change often considers himself a nervous person, that he frequently is troubled by constipation, that he has pains in his body, tics, spells of dizziness, and sleeplessness, are consistent with the correlation of $-.185 \pm .068$ with neurasthenic tendencies (list, p. 222) and of $-.142 \pm .069$ with sleep difficulties (list, p. 225). The probabilities, P, that these correlations are the results of chance are 1 in 10 and 1 in 5, respectively. The additional information that the subject is afraid of contracting disease, dreads the sight of a snake, considers life a burden, is not satisfactorily adjusted to life, is

TABLE 31

BLOOD-PRESSURE REACTION TO SHOCKS IN RELATION TO NEUROTIC INVENTORY SCORES

This table shows no consistent relation of blood-pressure changes t the neurotic inventory.

GROUP	Total N	SEX	LOW SCORE (NON-NEUROTIC)			MEDIUM SCORE			HIGH SCORE (NEUROTIC)		
			N	Neurotic Inventory Score	Average Blood-Pressure Reaction to Shocks	N	Neurotic Inventory Score	Average Blood-Pressure Reaction to Shocks	N	Neurotic Inventory Score	Average Blood-Pressure Reaction to Shocks
REACTION TO FIRST THREE SHOCKS											
I	30	M.	10	1	1.72				7	78	0.99
		F.	5	10	0.21				7	80	1.36
		M. and F.	15	14	1.40				14	106	1.10
					A.D. 1.33						A.D. 1.07
II	20	M.	6	11	0.91	2	31	2.74	1	49	1.89
		F.	1	00	−0.20	5	10	1.06	5	60	−0.11
		M. and F.	7	21	0.76	7	27	1.58	6	117	0.85
					A.D. 0.76			A.D. 0.95			A.D. 1.24
III and IV	26	M.	6	5	0.64	6	16	−0.37	7	55	−0.38
		F.	6	00	0.97	6	10	2.14	5	60	0.27
		M. and F.	12	12	0.92	12	31	0.56	12	129	0.91
					A.D. 1.39			A.D. 1.63			A.D. 1.50
Reaction to Second Three Shocks											
I	30	M.	10	1	1.72				7	78	1.68
		F.	5	80	0.04				8	80	0.95
		M. and F.	15	14	1.15				15	106	1.39
					A.D. 1.14						A.D. 1.70
II	20	M.	6	11	0.47	2	25	1.18	1	45	2.40
		F.	1	14	0.00	5	60	−0.30	5	10	0.19
		M. and F.	7	21	0.40	7	41	0.94	6	117	0.84
					A.D. 1.17			A.D. 0.86			A.D. 0.97
III and IV	26	M.	6	5	−0.66	6	16	−0.69	7	55	0.87
		F.	6	14	−0.33	6	34	0.71	5	14	1.48
		M. and F.	12	12	−0.49	12	58	0.02	12	129	0.69
					A.D. 0.70			A.D. 1.40			A.D. 1.09

troubled by certain useless ideas, is frequently excited, loses his temper, cannot stand the sight of blood, and is troubled by night-

TABLE 32

BLOOD-PRESSURE REACTION TO SHOCKS IN RELATION TO

This table gives indication of a tendency for larger reactions by "extroverts" than by "introverts."

Blood-
Pr. Reac-
to Shocks

Reaction to First Three Sh

Reaction to Second Three Shocks

mares, is consistent with the correlations of −.162 ± .068, −.251 ± .066, and −.178 ± .068, respectively, with the composite scores for anxiety, excitability, and paranoid tendencies. The lower intelligence test rating in the "neurotic" group is here, perhaps, significant.

The fact that persons who report themselves emotionally excitable under these various conditions tend to fall in the group having the minimum blood-pressure rise, is an unexpected finding, and the interpretation is not immediately apparent—the association of increased blood pressure with states of emotion (except in the case of physiological "shock," which is hardly indicated here) is too well established to be brought into question by these results. Perhaps, as in the case of the galvanic reaction, we must interpret the significance of the changes in relation to the physiological conditions immediately preceding and to the peculiarly *sensory* character of the stimulus. To give an adequate answer on this and on certain other matters, we must await the completion of an apparatus by which we may obtain continuous records of absolute, as well as of relative, blood-pressure change in human subjects.[1]

A comparison of the replies to the personality inventory made by the respective groups of 12 individuals representing in the highest degree the four possible combinations of $\genfrac{}{}{0pt}{}{\text{large } (+)}{\text{small } (-)}$ blood-pressure reactions with $\genfrac{}{}{0pt}{}{\text{large}}{\text{small}}$ galvanic reactions showed no clear evidence of relationships of any kind.

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[1] Wilder (1931) has recently offered evidence for a "law of initial value" (*Ausgangswertgesetz*) which may well be applicable in this situation. He observes that the higher the initial values for pulse and blood pressure, the less the tendency toward increase, and the greater the tendency toward a decrease in the magnitude of these measures following administration of drugs. The same principle operating under conditions of stimulation might account for the effects of electrical shocks on blood pressure as here observed. If we may infer from the data of the questionnaires that the "excitable" group is likely to show a higher level of excitation than others in approaching the standard situation, it is understandable, according to the "law of initial value," that they should show a greater tendency toward a drop in blood pressure on administration of the relatively mild electrical stimulation.

Questionnaire Items Relating to the Blood-Pressure Rise Following First Three Shocks

N = 92 (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank – = No

Questions Relative to Health

Do you consider yourself a rather nervous person? 2–9
min. 1 +.+.+.+,+.+,+,?.–,–,–,–,–,–,–,–,–,–,–,
2 +.+,+,+,+,+,?.–.–.–.–.–.–.–.–.–,–,–,–,
3 +.+,+,?,–.–.–.–.–.–.–.–.–,–,–,–,
4 +.+.+.?,?,–.–.–.–.–.–.–.–,–,–,–,–,–,–,
max. 5 +.+,+,–.–,–,–,–.–,–.–,–,–,–,–,–,–,–,–,

Are you troubled much by constipation? 1–5
min. 1 +.+,+,+,–,– –.–.–,–,–.–.–.–,–,–,–,–,–,
2 + +,+,–,–.–.–,– .–,–,–,– –,–,–,–,–,–,–,
3 +,?,–.–.–.–.–.– –.–.–.–,–,–,–,–,–,

ears so that you cannot sleep? 1–9
+.+,+,+,+,+,?.–.–.–.–.–.–.–,–,–,–,
–,? –.– –,–,–.–,– –.– –,–,–,–,–,–,–,

4 +.+,? –.–.–.–.–.–.–.–.–,–,–,–,–,–,–,–,
max. 5 +.?,–.–.–.–.–.–.–.–.–.–,–,–,–,–,–,–,–,

Do you often have bad pains in any part of your body? 4–3
min. 1 +.+.+.+,+,–.–.–.–.–.–.–.–,–,–,–,–,–,–,

max. 5 +.+,–.–.–.–.–.–.–.–.–.–,–,–,–,

Have you ever had spells of dizziness? 4–15

Do you usually sleep well? 7–6

Have you ever had the habit of twitching your face, neck, or shoulders? 7–16

min. 1 +.+ +.+,+.+,+,−.−,−.−,−.−,− −,−,−,−,−,
2 +,+,?.?,−.−.−,−.−.−.−,−.−,−,−,−,−,−,−,

Questions Relative to Emotion—Excitability, Depression, Etc.

Do you usually control your temper? 1–2

min. 1 + +.+.+ +.+.+.+,+,+,+,+,+,? ?,− − −,−,

Do you lose your head easily in a dangerous situatiot

min. 1 +.+ + +,−.−.−.−.−.−.− −,−,−,−,−,−.−

Do you lose your temper quickly? 3–16

min. 1 + +.+.+,+,?,− −.− − −.− -

3 + + +,− −.− −.− −.− −,−,−,−,
4 +,− − − −.− −.− − − − −,−,−,
max. 5 +.+.−.− −.−.−.−.−.−.−,−,−,−,

Are you often in a state of excitement? 6–9

Can you stand the sight of blood? 6–14

Are you frequently troubled with nightmares? 6–33

3 ?,–
4 –.–
max. 5 +.–

Are you often afraid of contracting disease? 3–25
min. 1 + + + + +,+,+,?.?,–.–.–.– –.–,–,–

Do you dread the sight of a snake? 4–25

4 + +
max. 5 + +

Do you feel that life is a great burden? 1–6

Do you feel that you are not satisfactorily adjusted to life? 7–14

Questions Relative to Social Orientation

Would you say that you are cynical about members of the opposite sex? 6–7

Do you frequently feel that you deserve a better lot than you have? 7–4

3 ?.?.?,?,–
4 +,+.?.?,–
st. 5 +.+,?.?,–

Do you have the habit of contradicting people? 5–25

min. 1 +.+.+.+.+,+,+,+,?,?,–.–.–.–.–.–.–,–,–,
2 + +,+ +,+,+,+,?.?,?,–,–.–,–,–.–,–,–,–,
3 +.+.?.?.?.?,?.–.–.–.–.–.–.–,–,–,

Do you ever cross the street to avoid meeting somebody? 6–11

min. 1 +.+ + + +.+,+,+,+,–.–.–.–.–.–,–,–,–,–,

MISCELLANEOUS QUESTIONS

Do your interests change quickly? 4–22

Do you like to take on responsibilities? 5–1

min. 1 +.+ +.+.+.+.+ +.+,+,+,+,+,+,+,+,?,–.–.

Does some particular useless thought keep coming into your mind to bother you? 6–26

min. 1 +.+.+.+,+,+,?.?,–.–.–.–.–.–.–,–,–,–,–, Do you dislike to write about yourself even to very close friends? 7-15

To summarize the conclusions here presented regarding the significance of the blood-pressure reaction to the sensory stimuli (shocks), it may be sufficient to indicate that a small or minus average blood-pressure reaction is likely to characterize a group of persons reporting numerous "neurotic" traits. The highest correlation (−.251 ± .066) appears with scores on excitability.

10. DECREASE (ADAPTATION?) IN THE GALVANIC REACTIONS TO SUCCESSIVE ELECTRIC SHOCKS

This measure is the average per cent galvanic reaction to the first three shocks minus the average per cent reaction to the second three shocks.

One of the most obvious characteristics of the profiles of electrical changes in response to successive stimuli is the decrease in the magnitude with repetition. We had assumed that this change would be largely a function of psychological and physiological adaptation, and that correlations would appear between this measure and the personality scores. Total scores on neither the neurotic inventory nor the introversion-extroversion test, however, offer any significant relationships (Tables 33 and 34), although we shall later show that this measure bears relation to certain kinds of questions in the inventory. No consistent tendency toward a correlation is evident from a study of the average arm movement and average shock intensities for the respective quintiles of this measure.

The assumption in formulating a measure of this kind was that an index of physiological or psychological adaptation would bear a definite relation to the adaptability to various life-situations reported by the subjects. Actually, the examination of the answers to the questions in the personality inventory makes it clear that the more excitable persons show the greatest degrees of adaptation. This may suggest that there is greater opportunity for adaptation in already excited than in non-excitable (already adapted?) persons.

TABLE 34

DECREASE (ADAPTATION?) OF GALVANIC REAC O SHOCKS IN RELATION

The range of adaptation represented in the respective quintiles of groups I–II and III–IV is given in Table 35.

There is no consistent difference between the distributions of men and women in the quintiles representing great and small recession of the galvanic reactions.

Persons with large adaptation are frequently members of fraternities or clubs, and few of them are on probation for scholastic deficiencies. Neither American Council Intelligence Test scores nor the number of grade-points during the first quarter show any consistent relation to this measure.

No consistent difference appears between the adaptation data of persons with high and those with low scores on the neurotic

DECREASE (ADAPTATION?) OF GALVANIC REACTION TO SHOCKS IN RELATION TO INTROVERSION-EXTROVERSION SCORES

This table shows no consistent relationships.

Grade	Total N	Sex	Low Score (Introvert) N	Low Score (Introvert) Introversion-Extroversion Score	Low Score (Introvert) Adaptation (?) Score	Medium Score N	Medium Score Introversion-Extroversion Score	Medium Score Adaptation (?) Scores	High Score (Extrovert) N	High Score (Extrovert) Introversion-Extroversion Score	High Score (Extrovert) Adaptation (?) Scores
II	21	M. F.	3 4	365 511 445	2.60 2.20	3 4	399 16 351	−3.47 −0.38	4 3	551 80 742	−2.58 7.43
		M. and F.	7		2.39	7		−1.70	7		2.39
					A.D. 2.15			A.D. 5.40			A.D. 5.95
III and IV	35	M. F.	7 5	364 511 997	0.96 2.46	7 4	399 16 351	0.80 −0.63	5 7	556 50 663	2.90 0.98
		M. and F.	12		1.17	11		−0.26	12		2.40
					A.D. 1.97			A.D. 4.04			A.D. 2.45

TABLE 35

MISCELLANEOUS DATA IN RELATION TO ADAPTATION

Groups	Quintiles	N	Range Adaptation (?) Scores	Sex (Percentage of Men)	Percentage Having Fraternity or Club Membership	Percentage on Probation
I-II. . . .	min. 1	10	−10.0 to −1.9	70.00	20.00	10.00
	2	10	−1.7 to 0.4	40.00	10.00	0.00
	3	10	0.5 to 2.3	80.00	20.00	0.00
	4	10	2.5 to 5.2	70.00	30.00	0.00
	max. 5	10	5.6 to 20.2	20.00	60.00	0.00
III-IV. . .	min. 1	9	−13.7 to −1.5	55.56	22.22	33.33
	2	9	−1.5 to 0.5	66.67	22.22	22.22
	3	7	0.6 to 1.7	42.86	28.57	14.28
	4	9	2.3 to 3.6	66.67	44.44	33.33
	max. 5	9	4.2 to 6.8	66.67	33.33	44.44

inventory or introversion-extroversion tests. We find, however, that persons with the maximum adaptation report with more than average frequency that they are upset easily, are upset if they lose in a competitive game, and are disturbed if seen by their friends in a five and ten cent store. A correlation of .196 ± .067 is found with the composite scores on excitability (list, p. 224). The probability, *P*, that this coefficient is due to chance is less than 1 in 10. If we were dealing here with an index of psychological adaptability, we should expect large scores to be correlated with small rather than with large emotional reactions. That the decreasing reaction to successive moderate electric shocks is associated with evidence of easy emotional upset would suggest that the real reason for the decrease in magnitude is an excessive response of the subject to the initial shocks, and that what we really measure is the return toward normal reactivity, or, perhaps, a phenomenon indicative of an initial exhaustion of the reaction mechanisms. The specific character of the subjects' inventory reports shows that this, which is possibly an initial overreaction, is associated with considerable concern for their safety and prestige.

QUESTIONNAIRE ITEMS RELATING TO ADAPTATION (?)

N = 93 (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank – = No

QUESTIONS RELATIVE TO EMOTIONAL STABILITY

Does it upset you to lose in a competitive game? 3–13

min. 1 +.+,–.–.–.–.–.–.–.–.–,–,–,–,–,–,–,

Do you get upset easily? 6–31

min. 1 +.?.–.–.–.–.–.–
2 +,?,?,–.– – –.–
3 + +,+,+,+,+,–,–
4 +.+.+.–,–.–.–.–
max. 5 + +.+.+,+,+,–.–

Do you mind having your friends see you in a 5 and 10 cent store? 7–13

Questions Relative to Social Orientation

Do you think most people are self-seeking or malicious? 1–11

+,?,–
2 +.+.+,?,?,?,–
3 +.+.+.+.+,?.–
4 +,+,?.? ?,–.–
max. 5 +.–.–.–.–.–.–

Have you found books more interesting than people? 3–5

max. 5 +.?,?,–.–.–.–.–.–

Are you troubled with sh
min. 1 +.+.+

Questions Relative to Orientation toward Reality

Do you frequently talk to yourself? 5–16

4 +,+,–.–.–.–.–.–.–.–
max. 5 +.+,–.–.–.–.–.–.–.–

Have you ever seen a vision? 4–2
min. 1 +.+.+,+,–.–.–.–.–.–

Do you have the habit of leaving a lot of tasks unfinished? *3-4*

min. 1 +.+.+.+.+,+,+,?.?,−.−.−.−.−.−,−,−,−,−,
2 +,+,+,?.?.−.−.−.−.−.−.−.−.−,−.−,−.−,−,
3 +,+,+,? ?,?,−.−,−,−,−.−,−,−,−,−,−,
4 +.+.?,−.−.−,−,−.−.−.−.−,−,−,−,−,−,−.−.
max. 5 +.?.?,−.−.−.−.−.−.−.−.−.−,−,−.−,−,−,−,

Do you faint easily? *8-14*

min. 1 +.+,−.−.−.−.−.−.−.−.−.−,−,−,−,−,−,−,−,

On the other hand, persons whose reactions later in the series are more nearly of the same size as their initial responses give suggestion of a tendency to flee from reality, especially from that involving social relationships. As shown in Table 35, few of them are members of fraternities or clubs, and there are several of them on probation for scholastic deficiencies. With more than average frequency they are troubled with shyness, talk to themselves, faint, see visions, find books more interesting than people, and regard people in general as self-seeking or malicious. The inconsistencies relative to these latter traits must, however, be rather marked, since only near-zero correlations appear with composite scores on measures such as "orientation toward reality," "paranoid tendencies," and "socially inactive tendencies."

In this measure of "adaptation" we have an index which is rather specific and which correlates with composite scores on only one of the personality variables we have tried to measure, e.g., excitability. The relationship is not, however, sufficiently high to be of value for prediction in individual cases.

11. SPONTANEOUS GALVANIC REACTIONS (PER CENT) DURING INTERVALS BETWEEN SHOCKS (NOT INCLUDING REACTION IMMEDIATELY AFTER THE STIMULUS)

This measure, as indicated in Table 36, manifests a low positive correlation with the strength of the shock and a somewhat higher correlation with the magnitude of the motor response to stimulation.

Table 37 gives the ranges of the respective quintiles of groups I–II and III–IV. The data included on sex show no consistent differences between the quintiles for large and small reactions. There is indication that the individuals with the larger reactions are most often members of fraternities or clubs. Averages for the respective quintiles show no relation of this measure to National Intelligence Test scores, grade-points during the first quarter, or the number of individuals on probation for scholastic deficiencies.

TABLE 36

REL SPONTANE REAL
SHOCKS TO THE STRE SHOC THE MAG-

Groups	Milliamperage of Standardized Shock	Magnitude of Motor Reaction
I–II	r = .254 ± .092	.326 ± .090
III–IV . . .	r = –.168 ± .161	.446 ± .086

TABLE 37

MISCELLANEOUS DATA IN RELATION TO SPONTAN
GALVANIC REACTIONS BETWEEN SHOCKS

Groups	Quintiles	N	Range (Per Cent Galvanic Reaction)	Sex (Percentage of Men)	Percentage Having Fraternity or Club Membership
I–II	min. 1	10	0.00 to 0.93	40.00	30.00
	2	10	0.97 to 2.65	40.00	20.00
	3	9	2.95 to 5.42	66.67	22.22
	4	10	5.43 to 7.92	50.00	30.00
	max. 5	10	8.06 to 18.70	70.00	50.00
III–IV . . .	min. 1	9	0.00 to 0.42	66.67	33.33
	2	9	0.45 to 1.43	44.44	11.11
	3	7	1.07 to 3.97	42.86	14.28
	4	9	4.82 to 7.52	77.78	22.22
	max. 5	9	8.10 to 22.43	66.67	66.67

The spontaneous reactions during the 30-second intervals between the shocks of the first series show, in Tables 38 and 39, little consistent difference between the reactions of individuals with high and low total scores on the neurotic inventory or introversion-extroversion tests. There is, however, a correlation of –.198 ± .071 with combined neurotic inventory scores from groups I–II and III–IV, and of $-.213 \pm .067$ with composite scores on "somasthenic tendencies" (list, p. 221) similar to that previously observed with spontaneous activity after the warning. The probability is near 1 in 20 so that these correlations might occur by chance. This measure of spontaneous change is not, however, to the same

TABLE 35

SPONTANEOUS GALVANIC REACTIONS (PER C
TWEEN SHOCKS IN RELATION TO NEUR   N SCORES

This table shows no consistent relation betwee   neurotic inventory and spontaneous galvanic reactions.

Group	Total N	Sex	Low Score (Non-neurotic)			Medium Score			High Score (Neurotic)		
			N	Neurotic Inventory Score	Average Reaction for Six Shocks	N	Neurotic Inventory Score	Average Reaction for Six Shocks	N	Neurotic Inventory Score	Average Reaction for Six Shocks
I	36	M.	10	5	4.66				4	75	6.47
		F.	6	10	4.01				5	80	4.53
		M. and F.	16	11	4.72				15	106	5.43
					A.D. 4.16						A.D. 4.32
II	40	M.	5	11	6.69	4	43	4.84	2	45	9.77
		F.	1	10	3.44	3	40	3.35	5	60	3.08
		M. and F.	6	22	6.42	7	42	5.76	7	103	4.49
					A.D. 5.11			A.D. 4.38			A.D. 3.08
III and IV	36	M.	6	1	7.06	6	10	5.57	7	75	7.55
		F.	6	10	3.56	6	60	4.32	5	17	1.04
		M. and F.	12	14	5.60	12	35	4.05	12	129	3.75
					A.D. 5.15			A.D. 3.58			A.D. 4.12

degree specific for physical weakness, as was true after the warning. The psychological factor is given greater influence in this measure, and we have a correlation of $-.150 \pm .069$ with "neurasthenic tendencies" (list, p. 222). Specific items such as constipation, stuttering, previous nervous breakdown, headache on one side, queer unpleasant sensations, and anemia, are shown by the accompanying histograms to be frequently characteristic of persons with the minimum of spontaneous reaction. A possible exception to the rule is the report of an episode of blindness, deafness, or dumbness by a few individuals with considerable spontaneous changes. Correlations of −.179±.068 with composite scores on "socially inactive" tendencies, and of −.135±.070 with "hyper-sensitivity," are of interest in conjunction with the already mentioned relation to fraternity or club memberships. Among the evidences of poor social orientation reported by persons with a minimum of spontaneous reaction are difficulty in making friends, failure to meet important persons at a social function, dissatisfaction with one's lot in life, shyness, feelings that people in general are self-seeking or malicious, allowing people to crowd ahead in line, failure in social conversation, and self-consciousness in recitation. "Disorientation toward reality" also appears slightly greater in those with minimum spontaneous reaction, feelings that they are not their "old selves," that things are "not real,"

SPONTANEOUS GAL C REACTIONS (PER CENT) DURING INTERVALS RELATION TO INTROVERSION-EXTROVERSION SCORES

This table shows a slight tendency for the extroverts to give larger reactions than

Group	Total N	Sex	Low Score (Introvert)			Medium Score			High Score (Extrovert)		
			N	Introversion-Extroversion Score	Average for Six Shocks	N	Introversion-Extroversion Score	Average for Six Shocks	N	Introversion-Extroversion Score	Average for Six Shocks
II	20	M.	2	367	3.79	3	500	4.05	4	557	10.47
		F.	4	to	3.51	4	to	3.56	3	to	6.03
				403			553			748	
		M. and F.	6		3.40	7		4.91	7		8.57
					A.D. 2.60			A.D. 2.32			A.D. 5.36
III and IV	35	M.	7	364	4.50	7	509	7.00	5	556	8.91
		F.	5	to	3.52	4	to	3.44	7	to	5.83
				508			552			664	
		M. and F.	12		3.86	11		5.78	12		8.00
					A.D. 2.85			A.D. 3.65			A.D. 2.96

and a disposition to talk to themselves being reported with much more than normal frequency. The correlation with the composite score on disorientation is, however, but −.100 ± .070. Emotional disturbances among persons with small reactions are evident from their reports that they have alternations of moods, that they are easily moved to tears, and that they have a great fear of fire; but the absence of correlations with the composite scores for related variables leads to a question of their significance.

In general, it may be said that spontaneous galvanic changes between stimuli are frequently small or lacking in physically weak and "neurasthenic" individuals. The relationship here demonstrated is not, however, sufficiently clear cut to be of predictive value in individual cases. These findings appear consistent with Syz's (1926) and Syz and Kinder's (1928) findings of a subnormal frequency of spontaneous reactions in catatonic cases. These workers also observed a subnormal frequency in depression and a high frequency in paranoid schizophrenia. Ödegaard (1930) reports results which in general are consistent with our observations in that he found a subnormal frequency of "continuous" curves in schizophrenia, depression, neuroses, and organic and toxic psychoses.

QUESTIONNAIRE ITEMS RELATING TO THE SPONTANEOUS GALVANIC REACTIONS BETWEEN REACTIONS TO SHOCKS

N = 92 (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank − = No

QUESTIONS RELATIVE TO HEALTH

Are you troubled much by constipation? 1–5
min. 1 +.+,+,+,-.-.-.-.-.-.-.-.-.-,-,-,-,-,-,

?,-.-.-.-.-.+.-.-.-.- -,-,-,-,-,
ver had the habit of stuttering? 1–7

Have you ever had a nervous breakdown? 2–13

min. 1 +.+.+,-.-.-.-.-.-.-.-.-,-,-,-,-,-,-,-,
2 +.+.?.-.-.-.-.-.-.-.-,-,-,-,-,-,-,-,-,
3 +.+
4 +.i

Is your head likely to ache on one side? 6–28

min. 1 +,+.+,+,-,-.-.-.-.-,-.-.-,-,-,

Do you often have queer unpleasant feelings in any part of your body? 7–31

3 + ?.-
4 +.-.-

Did you ever have anemia badly? 8–6

min. 1 +.+.+,?,-.-.-.-.-.-.-.-.

Have you ever been blind, half-blind, deaf, or dumb for a time? 6–5

min. 1 -.-.-,·,·,-.-.-.-.·.-.-,-,-,-,·,-,-,·,-,

max. 5 +.+,-,-.-.-.-,-,-.-.- -,-,-,-,-,-,-,-,

Questions Relative to Social Orientation

Do you make friends easily? 5–20

min. 1 + +,+.+,+,+.+,+,?,?,-.-,-.-,-,-,-,-,-,
2 +.+.+.+.+.+.+,+,+,+,+,+,+,?.?,-.-.-.-,
3 +.+.+,+.+.+.+,+,+,+,+,?,-.-.-.-,
4 +.+.+.+ +.+.+,+,+,+,+,+,+,+,?.?,-,-,-.
max. 5 +,+.+,+,+.+,+.+,+,+,+,+,+,+,+,?,-.-,-,

Is your mother dissatisfied with her lot in life? 6–20
min. 1 + +, +, +, +, ?, ?, ?, −, −, −, −, −, −, −, −, −, −, −,
2 +, +, +, ?, ?, ?, −, −, −, −, −, −, −, −, −, −, −, −,
3 +, ?, ?, ?, −, −, −, −, −, −, −, −, −, −, −, −.
4 +, +, +, ?, −, −, −, −, −, −, −, −, −, −, −, −
max. 5 ?, ?, ?, −, −, −, −, −, −, −, −, −, −, −, −, −, −, −, −,

At a reception or tea do you seek to meet the important person present? 6–23
min. 1 +, +, +, +, ?, ?, −, −, −, −, −, − −, −, −, −, −, −, −,

max. 5 + ·

Do you frequent

4 + + +, ?, ?, − −
max. 5 −, − −, −, − −, −

Are you shy with girls? 7–1.
min. 1 + +, +, +, +, +, +

max. 5 −, −, − −, − −, −, −, − − −, −, −, −, −, −, −, −, −,

Do you mind having your friends see you in a 5 and 10 cent store? 7–15

Do you think most people are self-seeking or malicious? 2–11
min. 1 +, +, +, +, ?, −, −, −, − −, −, −, −, −, −, −, −, −, −,
2 + + + +, +, +, +, ?, − − − − · − − −, −, −, −,
3 +, +, ? ?, −, −, −, −, −, −, −, −, −, −, −, −.
4 + +, ?, ?, ?, −, −, − −, − −, −, −, −, −, −, −, −, −, −,
max. 5 +, ?, −, −, − − −, − −, − −, −, −, −, −, −, −, −, −.

Were your parents partial to any of your brothers or sisters? 4–6
min. 1 +, +, +, +, ?, ?, ?, ?, −, −, −, − −, −, −, −, −, −, −,

3 ?, ?, ?, ?, −, −, −, −, −
4 ?, ?, ?, ?, ?, ?, ?, ?, −
max. 5 ?, ?, ?, ?, ?, ?, −, −, −

Do you allow people to crowd ahead in line? 4–18

min. 1 +.+.+.+.+,+,+,+,+,?.?.?.?,?,–.–.–.
2 + + +.+,+,?.?,?,?,?,–.–,–,–.–,–,–,
3 +.+.+,+,?,–.–.–.–.–.–.–.–,–,–,–,

max. 5 +,+,+,?.?,?,?,?,?,?,–,–,–,–,–,–, ,–,–,

Do you often feel that you do not get your chance in social conversation? 5–31

min. 1 +.+.+,+,?,–.–.–.–.–.–.–.–.–,–,–,–,–,–,

max. 5 +.– – –.– –.–.– – –.–,–,–,–,–,

Do you have difficulty in making friends? 5–4

Do you feel self-conscious when you recite in class? 6–18

Was your mother the dominant member of the family? 7–28

Do you often get interested in people you meet? 8–17

min. 1 +.+.+.+ +.+.+.+.+.+,+,+.+,+,+,?,–.–,–,
2 + + +.+.+ +.+,+,+,+,+.+,+,+,?.–.–,–.–,

BAHADUR

QUESTIONS RELATIVE TO ORIENTATION TOWARD REALITY

Are you ever bothered by a feeling that things are not real? 3–7

3 +.+.+.+,+,+,?.?.−,−
4 +.+.+.+,+,?.?,−.−.−
t. 5 +.+.+.+,?.?,?,−.−.−

Do you frequently talk to yourself? 5–16
min. 1 +.+.+.+,+,+,+,?,−.−.−.−.−.−

Do you ever have a queer feeling as if you were not your old self? 6–24
min. 1 +.+.+.+,+,+,+,+,?.?,−.−.−.−.−.−.−,−,−,

3 + +.+.+.?.?,−.−
4 +.+,+,+,?,−,−.−
max. 5 +.+,+,?,−.−.−.−

QUESTIONS RELATIVE TO EMOTION

Do your feelings alternate between happiness and sadness without apparent cause? 3–24
min. 1 + + +.+,+,+,+,+,?,?,?,−.−.−.−.−.− −.−,
2 +.+ + + +.+,+,?,− − −.−.−.−,−,−,−,−,

Are you easily moved to tears? 4–27
min. 1 +.+.+.+.+.+,+,+,−.−.−.

Do you have a great fear of fire? 5–10
min. 1 +.+.+.+,+,+,+,?,?,?,−.−
2 +.+.+,?.?,−.−.−,−,−,−,−
3 +,−.−.−.−.−.−.−.−,−,−,−
4 +.−.−.−.−.−.−.−.−.−,−
max. 5 +.+.−.−.−.−.−.−.−.−.−,−

12. PER CENT RESISTANCE CHANGE—INITIAL TO MINIMUM RESISTANCE[1]

This measure is calculated as follows:

$$\frac{\Delta \text{ resistance in } \omega}{\text{Initial resistance in } \omega} \times 100 .$$

This measure shows, in Table 40, no appreciable relation to the standard intensity of shock. There is a small positive correlation in both groups I–II and III–IV with the amount of recorded arm movement.

TABLE 40

RELATION OF TOTAL RESISTANCE CHANGE TO THE STRENGTH OF
[illegible] MAC
MO[illegible] REACTION

Groups	Milliamperage of Standardized Shock	Recorded Arm Movement
I–II	−.071 ± .095	.206 ± .095
III–IV	.095 ± .106	.188 ± .107

In Table 41 are given the ranges of resistance change within the respective quintiles. No consistent difference in resistance

MISCELLANEOUS DATA RELATING TO TOTAL RESISTANCE CHANGE (RESISTANCE BEFORE CLICKS TO MINIMUM PEAK REACHED IN FIRST SIX SHOCKS)

Groups	Quintiles	N	Range (Per Cent Resistance Change)	Sex (Percentage of Men)
I–II	min. 1	10	10.5 to 39.7	70.00
	2	10	40.6 to 49.0	70.00
	3	10	52.3 to 63.5	60.00
	4	10	66.5 to 74.3	50.00
	max. 5	10	74.5 to 88.0	20.00
III–IV	min. 1	9	18.0 to 32.5	55.56
	2	9	32.8 to 43.9	77.78
	3	5	44.9 to 49.1	40.00
	4	9	49.4 to 60.3	44.44
	max. 5	9	61.1 to 76.4	88.89

---

[1] Initial resistance is measured just preceding the non-conditioned clicks; minimum resistance, as here employed, is the lowest resistance reached during the first six shocks, as in section 13.

change characterizes the men and the women in the two groups. This measure shows no consistent relationship to American Council Intelligence Test scores, number of grade-points during the first quarter, number of persons who are fraternity or club members, or the number of those on probation.

TABLE 42

PER CENT RESISTANCE CHANGE—INITIAL A

This table shows no consistent relation between total resistance change and score on the neurotic inventory.

Group	Total N	Sex	Low Score (Non-neurotic) N	Low Score Neurotic Inventory Score	Low Score Per Cent Resistance Change	Medium Score N	Medium Score Neurotic Inventory Score	Medium Score Per Cent Resistance Change	High Score (Neurotic) N	High Score Neurotic Inventory Score	High Score Per Cent Resistance Change
I	30	M.	10	3	47.84				7	22	47.45
		F.	5	to	58.80				8	to	59.50
				14						106	
		M. and F.	15		51.39				15		53.83
					A.D. 19.21						A.D. 13.41
II	22	M.	6	11	43.90	2	23	65.94	2	43	77.16
		F.	3	to	65.30	5	to	55.78	5	to	72.56
				30			42			112	
		M. and F.	9		46.76	7		58.09	7		73.30
					A.D. 13.54						A.D. 3.46
								A.D. 13.55			
III and IV	34	M.	6	0	59.43	6	36	40.86	7	54	39.09
		F.	6	to	50.11	4	to	44.31	4	to	31.24
				35			53			149	
		M. and F.	11		54.91	10		42.06	11		35.20
					A.D. 11.74			A.D. 22.58			A.D. 11.34

Table 42 shows no consistent difference between the total resistance changes of persons with high and those with low scores on the neurotic inventory; nevertheless, combining the standard scores on the different groups gives a negative correlation with this measure of −.145 ± .072. Consistent with this finding is the correlation of −.134 ± .069 with "somasthenic tendencies." It is of interest that Syz and Kinder (1928) report a markedly subnormal total resistance decrease for catatonics and depressives under test conditions. Table 43 indicates somewhat larger total change for "extroverts" than for "introverts," the correlation coefficient for the combined data of groups II and III–IV being, however, only .086 ± .086. The answers to the personality inventory relative to uneasiness in a subway, unpleasant dreams, nightmares, and

PER CENT OF RESISTANCE CHANGE—INITIAL AND MINIMUM RESISTANCE IN RELATION TO INTROVERSION-EXTROVERSION SCORES

This table shows a tendency for the extroverts to manifest greater total resistance change than introverts.

Group	Total N	Sex	Low Score (Introvert)			Medium Score			High Score (Extrovert)		
			N	Introversion-Extroversion Score	Per Cent Resistance Change	N	Introversion-Extroversion Score	Per Cent Resistance Change	N	Introversion-Extroversion Score	Per Cent Resistance Change
II	21	M	3	461	54.07	5	509	65.52	4	455	56.95
		F	4	311	51.68	2	519	75.58	3	510	80.52
		M and F	7	461	45.30	7	554	70.89	7	532	63.13
					A.D. 8.11			A.D. 5.76			A.D. 13.48
III and IV	33	M	7	.184	43.77	7	500	57.86	5	556	43.16
		F.	5	10	45.00	3	510	43.97	6	610	50.39
		M and F.	12	507	42.61	10	550	53.89	11	665	45.18
					A.D. 13.03			A.D. 14.67			A.D. 7.06

blushing, suggest that persons having some anxiety tend to have maximum total resistance change, and a correlation of .111 ± .070 is obtained with composite scores on anxiety, and of .183 ± .069 with "hyper-sensitivity" to personal affront. A rather clear-cut tendency for those who are cynical about the opposite sex, and who mind having their friends see them in a five and ten cent store, to be persons with minimum total resistance change is also evident. Syz (1926) found that schizophrenics of a paranoid tendency were likely to show an excessive drop in resistance during experimentation. Cattell (1928) has noted that annoyance, depression, good "mental grip," and good physical condition frequently characterized persons with large total resistance change. In groups I–II the women, and in groups III–IV the men, show the largest total change.

QUESTIONNAIRE ITEMS RELATING TO TOTAL RESISTANCE CHANGE—INITIAL TO MINIMUM RESISTANCE

N = 91 (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank – = No

QUESTIONS RELATIVE TO EMOTION (ANXIETY?)

Does it make you uneasy to go into a tunnel or subway? 3–23

Are your daydreams usually about unpleasant things? 5–8
min. 1 –,–.–.–.–.–.–,–.–.–.–,–,–,–,–,–,–,–,–,

max. 5 +.+.+,–.– – – –.– –.–.–,–,–,

Are you bothered much by blushing? 6–27
min. 1 +.+.+,+,?.?,–.–

max. 5 +.+.+.+ +.+,+,+,+,+,?.–.– –.– –,–,–

Are you frequently troubled with nightmares? 6–33
min. 1 ?,–.–,–.–.– –.–.– –.–.–,–,–,–,–,–,–

3 ?,–.–,–.–.–,–.–.–,–.–.–,–,–,–,
4 +.+ –,–.–,–.–.– –,– –,–,–,–,–,–,–,–,–,
max. 5 +.+,–,–,–.–.–,– –,–,–,–,–,–,–,–,–,–,–,

QUESTIONS RELATIVE TO SOCIAL ORIENTATI

Would you say that e cynical about members of the opposite sex? 6–1

Do you mind having your friends see you in a 5 and 10 cent store? 7–13
min. 1 +,+,+,+,?,?,—,—,—,—,—,—,—,—,—,—,—,—,—

4 ?,—,—,—,—,—,—,—,—,—,—,—,—,—,—,—,—,—
max. 5 +,?,—,—,—,—,—,—,—,—,—,—,—,—,—,—,—,—

MISCELLANEOUS QUESTIONS

Do you usually sleep well? 7·6
min. 1 +,+,+,+,+,+,+,+,+,+,+,+,+,+,—,—,—,—

max. 5 +,+,+,+,+,+,+,+,+,+,+,+,+,+,+,+,+,+

Have you ever lost your memory for a time? 8–19

The per cent change from initial to minimum resistance shows a low order of relationship to scores on introversion-extroversion and to "anxiety." It is one of the less valuable of the measurements we have tested.

13. MINIMUM RESISTANCE REACHED DURING THE FIRST SERIES OF SHOCKS

The lowest resistance reached at the peak of any of the reactions to the first six shocks points, so far as it has significance, to the same tendencies as initial resistance. As in the case of this other measure (p. 77), minimum resistance shows some negative correlation with the milliamperage of the standardized shock in groups I–II, but no appreciable correlation in groups III–IV.[1]

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[1] In groups III–IV, where we have measurements of the voltage and resistance at the stimulating electrodes, there is a positive correlation between minimal D.C. resistance of the left hand (galvanic record) and A.C. resistance of the right arm and hand of .174 ± .124. Elimination of one case reduces this to −.092 ± .130. This correlation is contrasted with the negative correlation of −.289 ± .119 found for the relation between A.C. and initial D.C. resistances (note, page 83). In groups III–IV there is a correlation of .221 ± .121 for minimal D.C. resistance with the voltage of the standardized shocks.

Negative correlations are also found here in both groups I–II and III–IV between minimum resistance and the amount of recorded arm movement. This is additional evidence, especially in groups III–IV where there was no relation to shock intensity, of the reactivity of the skeletal musculature of persons with low resistances. Conversely, White (1930) demonstrated that muscular tension reduces and relaxation increases electrical resistance.

Correlations (r) of Minimum D.C. Resistance with the Standard Shock and Recorded Arm Movement

Groups	Milliamperage of Standardized Shock	A.C. Voltage of Standardized Shocks	Recorded Arm Movement
I–II	−.178±.088	. . .	−.318±.080
III–IV	.016±.105	.221±.111	−.389±.094

Miller (1926), by a high degree of muscular relaxation, reduced or completely eliminated the normal motor reaction to electric shocks. These facts all support the view that low resistance, muscular tension, and muscular reactivity are closely interrelated variables.

The range of resistances represented in the respective quintiles of groups I–II and III–IV are given in Table 45.

TABLE 45

Miscellaneous Data Relating to Minimum Resistance Reached during the First Series of Shocks

Groups	Quintiles	N	Range $\left(\frac{\text{Resistance in }\Omega}{1,000}\right)$	Sex (Percentage of Men)
I–II	min. 1	10	2.40 to 5.40	70.00
	2	10	5.50 to 7.70	70.00
	3	10	8.00 to 10.10	50.00
	4	10	10.10 to 17.10	40.00
	max. 5	10	20.00 to 115.00	50.00
III–IV	min. 1	9	3.50 to 4.20	44.44
	2	9	4.40 to 6.00	66.67
	3	5	6.90 to 7.65	80.00
	4	9	7.90 to 10.90	66.67
	max. 5	9	11.40 to 32.90	100.00

The averages of the American Council Intelligence Test scores, the grade-points during the first quarter, the number who were on probation for scholastic deficiency, and the number who reported membership in fraternities or clubs were compared for the individuals in the respective quintiles. No consistent relation appeared between these averages and resistance level.

MINIMUM RESISTANCE REACHED DURING THE FIRST SERIES O IN RELATION TO NEUROTIC INVENTORY SCORES

This table shows no consistent relationships.

Group	Total N	Sex	Low Score (Non-neurotic)			Medium Score			High Score (Neurotic)		
			N	Neurotic Inventory Score	Minimum Resistance 1,000	N	Neurotic Inventory Score	Minimum Resistance 1,000	N	Neurotic Inventory Score	Minimum Resistance 1,000
I	30	M.	10	5	24.65				7	35	8.76
		F.	4	10	26.50				4	10	26.63
		M. and F.	15	14	25.63				15	106	16.27
					A.D. 16.26						A.D. 13.41
II	31	M.	9	15	10.85	2	25	9.75	2	45	3.65
		F.	8	10	15.20	5	16	25.24	5	20	8.66
		M. and F.	7	23	13.90	7	42	20.74	7	107	8.26
					A.D. 8.80			A.D. 10.85			A.D. 5.09
III and IV	34	M.	6	5	6.87	6	16	12.02	7	75	9.89
		F.	6	10	6.61	4	16	6.08	5	60	5.38
		M. and F.	12	11	6.74	10	51	9.63	12	139	8.11
					A.D. 2.21			A.D. 3.64			A.D. 3.44

As was true of the initial resistance, the women here show a tendency toward high levels in groups I–II and toward low levels in groups III–IV. Since relationships with personality traits have been presented only when groups I–II and III–IV showed tendencies in the same direction, it seems probable that sex is not a determining factor in the regressions which have been considered.

TABLE 47

MINIMUM RESISTANCE REACHED DURING FIRST SERIES (SEVEN) SHOCKS IN RELATION TO INTROVERSION-EXTROVERSION SCORES

This table shows a tendency for introverts to have higher minimum resistance than extroverts.

	LOW SCORE (INTROVERT)	HIGH SCORE (EXTROVERT)
Minimum Resistance		

QUESTIONNAIRE ITEMS RELATING TO THE MINIMUM RESISTANCE REACHED DURING FIRST SERIES OF SHOCKS

$N = 91$ (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank − = No

QUESTIONS RELATIVE TO SOCIAL ORIENTATION

Do you think most people are self-seeking or malicious? 1–11

min. 1 + +,? −.− − − −,−.− −,−,−,−,−,−,−,−,
2 + +.?,−.−.−.−.−.− −.−.−,−,−,−,−.−,−,−,
3 +.+.+ ?.?.−.−.− −.−.−,−,−,−,−,

Are there many people you dislike intensely? 3–8

min. 1 + +.+.+,+,−.−.−.−.−.−.−.−,−,−,−,−

Do you feel that you are not satisfactorily adjusted to life? 7–14

min. 1 +.+.+.+,+,+,?.−.−.−.−.−.−.−,−,−,−,−,−,
2 +.+.+.+.+.+,+,+,+,?,?,−.−.−.−.−.−,−,−,
3 +.+.+.+.?,−.−.−.
4 +.+,+,+,+,?.?,−
max. 5 +.+,+,?,?,−.−.−

Do you think you are regarded as critical of other people? 8–13

min. 1 + +.+.+.+.+.+,+,+,+,+,−.−.−.−.−,−,−,−,

Do you *often* get interested in people? 8–17

QUESTIONS RELATIVE TO HEALTH

Do you ever talk in your sleep? 3–22

min. 1 +.+ +,? −.− −.− −,−.−.−,−,−,−,−,−,−,−,
2 +.+.+,?,?,−.−.−.−.−.−.−.−.−,−,−,−,−,−,
3 +.+.+.+,+,+,? ?.? ?.−.−.−.−,−,
4 +.+.+.+,+,?.?,?,?,−.−.−.−.−.−.−,−,−,−,
max. 5 +.+.+ +,+,+,+,?,?,−.−.−.−.−.−.−.−,−,−,

Do you find it necessary to watch your health carefully? 3–34

2 +.+.+,?,−.−.−
3 +.+.+,+,?.?,−
4 +.+,+,+,?.−.−
max. 5 +.+.+.+ +,+,+,

Have you ever been blind, half-blind, deaf, or dumb for a time? 6–5

Miscellaneous Questions

Do you often feel just miserable? *6–25*

3 + +.+.+.+,?.–.– –.– –.–,–,–,–.
4 +.+.+.–.–.–.–.–.–.–.–,–,–,–,–.
max. 5 +.+,+,?.?.?.?,–.– –.– –.–.–.–,–.

Are you frightened by lightning? *8–2*

This measure shows no consistent relation to scores on the neurotic inventory or to the introversion-extroversion test. Here again, as in the case of initial resistance, we find low negative correlations, this time of $-.181 \pm .068$ with "paranoid" tendencies, and of $-.185 \pm .068$ with depression. The probability, P, is 1 in 10 that these are attributable to chance. As shown in the histograms, persons with low resistances more frequently than the average report disliking people intensely and being considered critical of others. They appear quite non-paranoid, however, in not considering most people "self-seeking or malicious."

This measure also gives a low order correlation of $-.117 \pm .070$ with composite scores on excitability (p. 224). Only one item regarding excitability, that about being frightened by lightning, has, however, been differentiated by the technique used in selecting the histograms. Evidence for the greater motor excitability of the individuals with low resistance has been already mentioned.

Our results suggest a slight tendency, too low for predictive purposes, for low resistance to be associated with depression and paranoid tendencies.

14. GALVANIC RECOVERY DURING THREE SECONDS AFTER THE PEAK OF REACTION TO SHOCKS

As an index of the rate of recovery we have arbitrarily chosen the percentage recovered during 3 seconds following the peak[1] of the galvanic reaction. This is an interval long enough to include the steepest portion of the recovery curve and short enough not appreciably to overreach the recovery period for the smaller reactions.

In the majority of the studies employing the galvanic skin reflex, the concern of the investigators has been either (1) with the level of resistance or (2) with the magnitude of the response to stimulation. There has been little controlled study of the possible significance of the curve of recovery. The alterations in form of the recovery curve attending changes in the subject's resistance are illustrated in the sample record of Figure 1. It will be seen that there is little or no recovery of resistance after the peak of the reaction in the case of the first shock, but much greater recovery after later stimuli. We have shown (Darrow, 1931), by cinemicrophotographs of the sweat-gland orifices and of the shadow of a galvanometer pointer projected on this same skin area, that galvanic reaction occurring without visible perspiration is followed by little or no immediate recovery of resistance, but that, as resistance drops and perspiration becomes more profuse, the recovery becomes more marked. The importance of recovery rate becomes evident from a study of its relationships (1) to the level of resistance at which the recovery occurs,[2] (2) to the magnitude of the preceding reaction, and (3) to the psychological and

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[1] Peak – the point of maximum reduction in apparent resistance following excitation. The calculation of percentage of recovery is as follows:

$$\frac{\text{Recovery during 3 seconds}}{\text{Resistance at peak of reaction}} \times 100 .$$

[2] That this is not simply a function of the method of calculation is demonstrated by the facts to be treated under separate title: (1) that the relationship holds when the angle of recovery (degrees from base line to a tangent to the steepest part of the recovery curve) is plotted against peak resistance; (2) that the angle of recovery and the percentage of recovery tend to give a straight line when plotted against one

physiological state of reactivity of the subject as determined by other criteria.

As evident in Table 48, recovery shows little relation to the strength of shock but is significantly correlated with initial resistance, with the size of the galvanic reactions, and with the reactivity of the skeletal musculature. There is also a positive relationship, when resistance level is constant, between the magnitude of reactions of a subject and rate of his recovery. In the case of those responses where the subject's reactivity appears to be near its maximum, and the subject's resistance near the minimum, the recovery following the peak approaches in magnitude the value of the preceding reaction. In the case of those reactions where the resistance of the subject after reaction is far above the minimum, the recovery is zero or negative. Whether or not the

TABLE 48

Correlations between Per Cent Galvanic Recovery during 3 Seconds and Other Important Physiological Measures

Groups	Milliamperage of Standardized Shock	Recorded Arm Movement	Initial Resistance	Galvanic Reaction
I-II.	.131 ± .102	.337 ± .097	−.303 ± .095	.582 ± .069
III-IV. .	−.050 ± .104	.447 ± .088	−.422 ± .088	.782 ± .040

Miscellaneous Data Relating to the Per Cent Recovery after the First Three Shocks

Groups	Quintiles	*N*	Range (Percentage of Recovery)	Sex (Percentage of Male)	Percentage of Fraternity or Club Membership
I-II.	min. 1	9	−1.1 to 2.2	44.44	33.33
	2	9	2.2 to 3.6	44.44	22.22
	3	6	4.0 to 5.2	50.00	16.67
	4	9	5.0 to 7.0	88.89	22.22
	max. 5	9	8.7 to 16.3	55.56	55.56
III-IV.	min. 1	9	0.4 to 2.3	77.78	22.22
	2	9	2.4 to 4.2	66.67	11.11
	3	6	4.3 to 5.1	66.67	50.00
	4	9	5.6 to 7.4	44.44	44.44
	max. 5	9	7.7 to 18.9	55.56	33.33

TABLE 50

PER CENT GALVANIC RECOVERY IN RELATION TO NEUROTIC INVENTORY SCORES

PERCENTAGE OF CHANGE DURING 5 SECONDS FOLLOWING PEAK

This table shows no consistent relationship between these

Group	Total N	Sex	Low Score (Non-neurotic) N	Low Score (Non-neurotic) Neurotic Inventory Score	Low Score (Non-neurotic) Average Per Cent Recovery	Medium Score N	Medium Score Neurotic Inventory Score	Medium Score Average Per Cent Recovery	High Score (Neurotic) N	High Score (Neurotic) Neurotic Inventory Score	High Score (Neurotic) Average Per Cent Recovery
Average Per Cent Recovery, First Three Shocks											
I	27	M.	10	3 to 14	4.80				8	71 to 206	6.70
		F.	5		3.10				4		1.05
		M. and F.	15		4.28				12		5.15
					A.D. 3.33						A.D. 2.50
II	16	M.	3	15 to 41	4.40	2	42 to 47	7.61	2	48 to 177	7.25
		F.	1		3.30	4		7.28	4		8.60
		M. and F.	4		4.13	6		7.40	6		8.15
					A.D. 0.89			A.D. 3.87			A.D. 4.89
III and IV	36	M.	6	5 to 15	8.05	6	16 to 73	3.61	7	74 to 129	3.70
		F.	6		7.58	6		7.88	5		3.30
		M. and F.	12		7.80	12		5.06	12		3.50
					A.D. 4.46			A.D. 3.07			A.D. 1.58
Average Per Cent Recovery, Second Three Shocks											
I	30	M.	10	3 to 14	6.42				9	71 to 206	9.45
		F.	5		8.36				6		3.90
		M. and F.	15		7.07				15		6.48
					A.D. 4.36						A.D. 3.85
II	20	M.	5	21 to 31	5.34	2	32 to 43	11.00	2	45 to 117	9.60
		F.	1		6.90	5		6.90	5		10.26
		M. and F.	6		5.53	7		8.16	7		10.08
					A.D. 1.84			A.D. 5.09			A.D. 4.80
III and IV	36	M.	6	5 to 15	8.30	6	16 to 33	4.82	7	75 to 229	6.09
		F.	6		9.49	6		9.53	5		6.06
		M. and F.	12		8.90	12		7.00	12		6.08
					A.D. 2.13			A.D. 3.21			A.D. 2.69

rate of the recovery will prove to be a function of metabolic, biochemical, physical, or purely psychological factors is not our chief concern in this discussion. The important fact is that there appear certain relations between a measure of recovery and certain data on personality.

TABLE 51

PER CENT GALVANIC RECOVERY IN RELATION TO
N SCORES

This table shows a slight tendency for e
introverts.

% Per Cent Recovery, First Three Shocks

M.
F
M. and F.

The ranges of the recovery included in the respective quintiles of groups I–II and III–IV are presented in Table 49. It may be noted from the percentage of men in the various quintiles that there is no significant difference between the distribution of men and women with respect to this measure.

The available data from the recorder's office of the University indicate that members of fraternities or clubs are found a little more frequently than non-members among those with large recovery rates. The American Council Intelligence Test scores, number of grade-points, and the number of persons on probation show no such relation.

From Tables 50 and 51 it can be seen that rate of recovery bears no consistent relation to the total scores on either of the personality tests, although the combined standard scores of groups I–II and III–IV show a prevailing tendency toward correlation with the neurotic inventory of $-.213 \pm .074$.

QUESTIONNAIRE ITEMS RELATING TO PER CENT GALVANIC RECOVERY DURING 3 SECONDS FOLLOWING PEAK OF REACTION

N = 84 (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank – = No

QUESTIONS RELATIVE TO GENERAL HEALTH

Did you ever have anemia badly? 8–6
min. 1 +.+.+.+,?,–.–.–.– –.–.–,–,–,–,–,–,–
2 + – – – – – – –.– –,–,–,–,–,–,–,–,–
3 ? –.– – – –.–,–,–,–,–,
4 ? – –.–.–.–.–.–.–,–,–,–,–,–,–,–,–,
max. 5 ? ? –.– – – – – – –,–,–,–,–,–,–,–,–.

Do things ever swim or get misty before your eyes? 8–16
min. 1 + + +,+.+.–.–.–.– –.–.–.–,–,–,–,–,–,
2 + + +,+,?,–.–.– –,–.–.–.–,–,–,–,–.–,–.
3 + + +,– –.–.–.–,–,–,–,–,
4 + +,– –.–.–.– –,–.–.– –,–,–,–,–,–.–,–,
max. 5 + +,?.–.–.–.–.–.–.–.–,–,–,–,–,–,–,–.

Are you ever bothered by fluttering of the heart? 8–21
min. 1 + + +,– –.–.–.– –.– –,–,–,–,–,–,–,–,
2 +.–.–.– –.–.–.–.–.–,–,–,–,–,–,–,–,–,
3 +.+.+, – –.– –,–,–,–,–,–,
4 ?,–.–.–.–.–.–.–.–.–,–,–,–,–,–,–,–,
max. 5 –.–.–,–.–.–.–.–.–,–,–,–,–,–,–,–,–,

Do you find it necessary to watch your health carefully? 3–34

min. 1 +,+,+,+,+,−,−,−,−,−,−,−,−,−,−,−,−,−,
2 +,+,+,+,?,−,−,−,−,−,−,−,−,−,−,−,−,−,
3
4
max. 5

Questions Relative to Social Orientation

Do you take responsibility for introducing people at a party? 1–10

min. 1 +,+,+,+,+,+,?,?,?,−,−,−,−,−,−,−,−,−,
2 +,+,+,+,+,+,+,+,+,?,?,?,?,?,?,−,−,−,
3 +,+,+,+,+,+,?,?,?,−,−,−,
4 +,+,+,+,+,+,+,+,+,+,?,?,?,−,−,−,−,−,
max. 5 +,+,+,+,+,+,+,+,+,+,+,?,−,−,−,−,−,−,

Have you found books more interesting than people? 3–5

min. 1 +,+,+,+,+,+,+,+,+,+,+,?,?,−,−,−,−,−,
2 +,+,+,+,+,+,+,?,?,−,−,−,−,−,−,−,−,−,
3 +,+,+,+,?,?,−,−,−,−,−,−,
4 +,+,+,?,−,−,−,−,−,−,−,−,−,−,−,−,−,−,
max. 5 +,+,+,?,?,−,−,−,−,−,−,−,−,−,−,−,−,−,

Do you ever cross the street to avoid meeting somebody? 6–12

min. 1 +,+,+,+,+,+,+,+,+,−,−,−,−,−,−,−,−,−,
2 +,+,+,+,+,+,+,+,+,+,+,?,−,−,−,−,−,−,
,−,−,−,−,
,−,−,−,−,−,−,−,−,−,−,
,−,−,−,−,−,−,−,−,−,−,

Do you like to be with other people a great deal? 6–13

min. 1 +,+,+,+,+,+,+,+,?,?,−,−,−,−,−,−,−,−,
2 +,+,+,+,+,+,+,+,+,?,?,?,−,−,−,−,−,−,
3 +,+,+,+,+,+,+,−,−,−,−,−,
4 +,+,+,+,+,+,+,+,+,+,+,+,+,?,?,−,−,−,
max. 5 +,+,+,+,+,+,+,+,+,+,+,+,+,+,?,−,−,−,

Do you get tired of people quickly? 7–22

min. 1 +,+,+,+,+,+,+,+,?,−,−,−,−,−,−,−,−,−,
2 +,+,+,+,+,+,+,?,?,?,−,−,−,−,−,−,−,−,
3 +,+,+,+,?,−,−,−,−,−,−,−,
4 +,+,?,−,−,−,−,−,−,−,−,−,−,−,−,−,−,−,
max. 5 +,+,+,?,−,−,−,−,−,−,−,−,−,−,−,−,−,−,

Do you find it difficult to speak in public? 7–27

min. 1 +.+.+.+,+,+,+,+,–.–.–.–.–.–,–,–,
2 +,+.+.+.+,+,+,?,?,–.–.–.–.–.–,–,
3 +,+ +,+,?.?,–,–.–.–,–,–,
4 +.+,+,+,?.?,?,–,–.–,–,–,–,–,–,–,
max. 5 +.+.?.?,–.–.–.–.–.–.–,–,–,–,–,–,

Miscellaneous Questions

Can you stand disgusting smells? 3–21

min. 1 +.+.+,+,+,+,+,?.?.?,–.–,–,–.–,–,–,–
2 +.+.+,+,+,?.?,–.–.–.–,–.–.–,–,–,–,–

-,?.?,?

Does it make you uneasy to go into a tunnel or subway? 3–23

Do you feel you must do a thing over several times before you leave it? 8–5

min. 1 +.+.+.+.+,+.+,+,+,?.?.–.–.–.–,–,–,–,

Do you daydream frequently? 4–10

3 +.+.+,+,+,?.?,–,–,–,–,–,
4 +.+ +,+,+,+,+,–.–.–.–.–.–
x. 5 +,+.+.+ +,+,+,+,?.?.?,–.–

Is your mother dissatisfied with her lot in life? 6–20

Are you shy with girls? 7–12
min. 1 +,+,+,+,+,+,?,?,–.

This index of recovery finds its best correlation with the composite score on physical health—"somasthenic tendencies." The value of r here is $-.165 \pm .068$ with a probability, P, of 1 in 100 that it is due to chance. The histograms show that persons with low recovery frequently report previous anemia, swimming before the eyes, fluttering of the heart, and necessity to watch the health. Correlations of $-.118 \pm .073$ with neurasthenic tendencies and of $-.133 \pm .072$ with sleep difficulties offer additional evidence regarding the relation of health to recovery rate. Furthermore, a correlation of $-.200 \pm .071$ with composite scores on "socially inactive tendencies," along with such evidence as is available from the data on fraternity or club memberships, suggests a possible relation of the health factors to social effectiveness.

It is evident that in this measure of recovery rate we have a correlate chiefly of physical vitality and social effectiveness. The correlation is not sufficiently high to be reliable for prediction in individual cases.

15. RECOVERY-REACTION QUOTIENT (AVERAGE FOR FIRST THREE SHOCKS)

The recovery-reaction quotient for each shock is calculated as follows:

$$\frac{\text{Increase in resistance (in } \omega\text{) during 3 seconds following the peak of the reaction}}{\text{Decrease in resistance (in } \omega\text{) from stimulus to peak}^{1}}$$

This measure does not appear, from averages of the respective quintiles, to be a function of the standard strength of shock or of the magnitude of the recorded motor reaction.

There is evident in Table 52 a tendency for women to have lower quotients than men in groups I–II. This tendency, however, is hardly apparent in groups III–IV. The fact that the correla-

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[1] Peak: see note 1, page 161.

tions which have been offered by histograms are dependent upon regressions in both groups I–II and III–IV is some evidence that sex has not been a determining factor, at least in the histograms.

Examination of averages for the respective quintiles shows that this measure bears no relation to the American Council Intelligence Test scores, to the number of grade-points made during the first quarter, to the number of individuals on probation for scholastic deficiencies, or to the number of persons belonging to fraternities or clubs.

TABLE 52

Data Relating to Recovery-Reaction Quotient

Groups	Quintiles	N	Range (Recovery-Reaction Quotient)	Sex (Percentage of Men)
I–II	min. 1	9	0.000 to 0.090	22.22
	2	9	.110 to .175	44.44
	3	6	.184 to .226	66.67
	4	9	.231 to .286	66.67
	max. 5	9	.323 to .570	77.78
III–IV	min. 1	9	.075 to .174	55.56
	2	9	.181 to .279	55.56
	3	6	.281 to .302	83.33
	4	9	.309 to .380	66.67
	max. 5	9	0.395 to 0.556	55.56

By dividing galvanic recovery by galvanic reaction, we are able largely to eliminate the effects of certain factors which are common to both measures, such, for instance, as the effect of physiological reactivity upon the magnitude of the galvanic changes. On the other hand, certain factors which tend to enhance the reaction and to retard recovery, as, for example, conditions of irritability or anxiety, are accentuated by this procedure. We find by examination of the answers to the various questions that persons with a small recovery-reaction quotient are in a disproportionate number of cases susceptible to emotional disturbances. We also find smaller quotients among individuals with high "neurotic" scores in Table 53, and a correlation of −.166±.076 between recovery-reaction quotients and total neurotic inventory scores. No relation with introversion-extroversion is apparent either in Table 54 or by means of the method of correlation.

Examination of the data relating to health shows a high incidence of persons with low recovery-reaction quotients who have trouble with the sound of the heart in their ears preventing sleep, pains in the eyes, and nervousness, all of which, however, are possibly neurasthenic symptoms. The correlation with composite scores on Health No. 1 ("somasthenic" tendencies) is .191 ± .071, and with Health No. 2 ("neurasthenic" tendencies) is .239 ± .069. The probability, P, that these might be attributed to chance are 1 in 10 and 1 in 50, respectively. In keeping with these observations is the fact that many answers relative to the inner emotional life of these persons reveal a marked excitability and a predisposi-

THE RECOVERY-REACTION QUOTIENT IN RELATION TO NEUROTIC INVENTORY SCORES

AVERAGE FOR FIRST THREE SHOCKS

This table shows in groups II and III-IV a tendency for "neurotic" persons to have a low recovery-reaction quotient.

Group	Total N	Sex	Low Score (Non-neurotic)			Middle Score			High Score (Neurotic)		
			N	Neurotic Inventory Score	Recovery-Reaction Quotient	N	Neurotic Inventory Score	Recovery-Reaction Quotient	N	Neurotic Inventory Score	Recovery-Reaction Quotient
I.	27	M.	10	5	0.246				6	72	0.267
		F.	5	10	0.426				6	80	0.236
		M. and F.	15	14	0.390				12	106	0.212
					A.D. 0.108						A.D. 0.050
II.	16	M.	3	[illegible]	0.409	2	[illegible]	0.228	2	[illegible]	0.291
		F.	1	[illegible]	0.134	4	[illegible]	0.313	4	[illegible]	0.110
		M. and F.	4	[illegible]	0.360	6	[illegible]	0.241	6	117	0.150
					A.D. 0.124			A.D. 0.117			A.D. 0.070
III and IV. . .	35	M.	6	5	0.367	8	36	[illegible]	7	75	0.272
		F.	6	18	0.345	3	40	0.306	5	80	0.161
		M. and F.	12	22	0.356	11	53	0.256	12	129	0.267
					A.D. 0.087			A.D. 0.050			A.D. 0.044

tion toward states of anxiety. They often have feelings easily hurt; they get rattled easily, have fear of fire, are often excited, are troubled by blushing, are made uneasy by crossing a bridge or going into a subway, fear that they may jump from high places, find it difficult to speak in public, believe that people

TABLE 54

The Recovery-Reaction Quotient in Relation to
in-Extroversion Scores

This table shows no consistent differe

make fun of them, and are bothered by feelings that things are not real. Correlations ranging from .139 to .188 occur with the composite scores on the various items in what we have termed the "neurotic syndrome." This syndrome includes, in addition to "neurasthenic tendencies," "socially inactive tendencies," "hyper-sensitivity," "depression," and "anxiety." This measure also correlates .168 ± .072 with "disorientation toward reality." There appears one inconsistency in the histograms, i.e., that these individuals with the lowest quotients and the highest frequency of anxiety report the least fear that they are in any way sexually inferior. In this case we may, of course, call upon psychoanalysis for an explanation, or we may attribute the results to chance.

QUESTIONNAIRE ITEMS RELATING TO THE RECOVERY-REACTION QUOTIENT

$N = 84$ (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank – = No

QUESTIONS RELATIVE TO GENERAL HEALTH

Does your heart sometimes sound in *your* ears so that you cannot sleep? 1–9

Do you consider yourself a rather 1
min. 1 + +.+,+,+,–.–,–.–.-

Do your eyes often pain you? 5–15

QUESTIONS RELATIVE TO EMOTION AND ANXIETY

Are you frequently troubled with nightmares? 6–33

Are you bothered much by blushing? 6–27
min. 1 +.+.+.+.+,+,+,–.–.–.–.–.–,–

Have you ever been afraid that you might jump off when you were in a high place? 4–13

Have you ever been afraid that you are sexually inferior to other men (other women)? 4–5

Are your feelings easily hurt? 2–14

Do you get rattled easily? 3–18

max. 3 +, +, +, ? ? – – – – – –, –, –, –, –, –, –, –,

Does it make you uneasy to go into a tunnel or subway? 3–23

Does it make you uneasy to cross a bridge over a river? 4–21

Do you have a great fear of fire? 5–19
min. 1 +.+,+,?.?,–.–.–.–.–.–.–.

Are you often in a state of excitement? 6–9
min. 1 +.+.+,+,+,+,?.?,–,–.–.–.–,–.

QUESTIONS RELATIVE TO SOCIAL ORIENTATION

r parents partial to any of your brothers or sisters? 4–6

Would you say that you are more or less ignorant of sex? 5–30
min. 1 +.+.+,+,+,?,?,–.–,–.–,–,–,–,–,–,–,–,
2 +.+.+,?,–.–.–.–.–.–.–.–,–,–,–,–,–,–,
3 ?,–.–.–.–.–.–.–,–,–,–,–,
4 +,+,?,–.–.–.–.–.–.–.–.–,–,–,–,–,–,
max. 5 +,–.–,–.–.–.–.–.–.–.–,–,–,–,–,–,–,–,

Do you think people have made quite a lot of fun of you? 6–16

Do you find it difficult to speak in public? 7–27
min. 1 +.+.+.+.+.+,+,+,+,?,–.–.–.–.–,–,–
2 +.+.+.+,+,+,+,?.?.?,–.–.–.–.–,–,–
3 +.+.?,–,–.–,–.–,–,–,–,–,
4 +.+.+,+,+,+,?,–.–.–.–.–.–.–,–,–,–
max. 5 +,?.?,?,–.–.–.–.–.–.–.–.–,–,–,–,–

If you see an accident, are you quick to take an active part in giving help? 8–4
min. 1 +,+,+,+,?,?,?,?,?,?,?,-,-,-,-,-,-,-,
2 +,+,+,+,+,+,+,+,+,+,?,?,?,-,-,-,-,-,
3 +,+,+,+,+,+,?,-,-,-,-,-,
4 +,+,+,+,+,+,+,+,+,?,?,?,?,?,-,-,-,-,
max. 5 +,+,+,+,+,+,+,+,+,+,+,+,+,?,?,-,-,-,

Questions Regarding Orientation toward Reality

Are you ever bothered by a feeling that things are not real? 3–5
min. 1 +,+,+,+,+,+,+,+,+,+,?,-,-,-,-,-,-,-,

3 +,+,+,+,+,?,-,-,-,-,-,-,
4 +,+,?,?,?,?,?,-,-,-,-,-,-
max. 5 +,+,+,+,+,?,-,-,-,-,-,-,-

Have you ever seen a vision? 4–1
min. 1 +,+,-,-,-,-,-,-,-,-,-,-,-

max. 5 ?,-,-,-,-,-,-,-,-,-,-,-,-,-,-,-,-,

From the numerous relationships which the recovery-reaction quotient bears to the measures of "neurotic" and emotionally unstable tendencies we may consider it one of our best indicators of absence of "neurotic" trend. The coefficients of correlation are not, however, sufficiently high to justify the use of the measure for prediction in individual cases.

16. PER CENT GALVANIC REACTION TO THE CONDITIONED STIMULI

This measure is obviously a function (1) of the skeletal and visceral reactivity of the subjects and (2) of their tendency to form associations between the non-conditioned and the conditioning stimuli. Exactly how much is contributed to this measure by each of these factors is difficult to say. In a later section ("Percentage of Association"), however, the conditioning will be treated by a method which largely eliminates differences in galvanic reactivity as a factor.[1]

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[1] While the evidence of the conditioning of the galvanic reaction is very marked, as is seen from a comparison of the averages of conditioned and non-conditioned

A study of the relation of this variable to other physiological measures in Table 55 reveals positive correlations with the strength of the shocks in groups I–II, where double intensity was employed; with the magnitude of the recorded arm movement after the shocks in both groups I–II and III–IV; and with the magnitude of the galvanic reactions to the shocks in both groups I–II and III–IV. The latter rather marked positive correlation with the galvanic reaction to the shocks is to be expected, if for no other reason than that the magnitude of the responses under the two conditions is to no small extent a function of the lability of the secretory and other skin mechanisms in the different subjects.

TABLE 55

THE CORRELATION OF CONDITIONED GALVANIC REACTIONS WITH PHYSIOLOGICAL FACTORS IN CONDITIONING

Groups	Milliamperage of Standardized Shock	Recorded Arm Movement after Shocks	Galvanic Reaction to Shocks
I–II	.209 ± .091	.219 ± .095	.581 ± .063
III–IV	.003 ± .103	.283 ± .090	.367 ± .042

TABLE 56

MISCELLANEOUS DATA ON THE PER CENT (
TO THE CONDITIONED STIM

Groups	Quintile	*N*	Range (Per Cent Galvanic Reaction)	Sex (Percentage of Men)	Percentage of Fraternity or Club Membership	American Council Intelligence Test Score
I–II. . . .	min. 1	10	0.0 to 4.8	60.00	30.00	170.7
	2	10	4.8 to 8.4	50.00	20.00	184.3
	3	10	8.8 to 10.9	40.00	10.00	174.0
	4	10	11.0 to 17.3	60.00	50.00	176.6
	max. 5	10	19.1 to 37.3	60.00	60.00	215.4
III–IV.	min. 1	9	0.4 to 4.7	66.67	22.22	180.8
	2	9	5.0 to 7.7	88.89	11.11	183.9
	3	7	8.2 to 9.7	57.14	14.28	203.4
	4	9	10.4 to 12.0	33.33	55.56	208.7
	max. 5	9	13.3 to 28.5	55.56	44.44	200.4

---

responses in Table 61 (p. 238), the size of the conditioned as compared with the non-conditioned reactions in various individuals does not yield significant differences with respect to personality. We shall not, therefore, present data on this other comparison.

The correlation of the conditioned galvanic response with the record of arm movement in response to the shock, along with certain neurological facts to be referred to later, suggests the possibility of a motor factor in the formation of the conditioned visceral reactions.

Table 56 gives the ranges within the quintiles of groups I–II and III–IV. No marked difference appears in the distribution of

TABLE 57

PER CENT GALVANIC REACTION TO THE CONDITIONED STIMULUS IN RELATION TO NEUROTIC INVENTORY SCORES

This table shows no consistent difference between the reactions of "neurotic" and "non-neurotic" groups.

Group	Total N	Sex	Low Score (Non-neurotic)			Medium Score			High Score (Neurotic)		
			N	Neurotic Inventory Score	Average Per Cent Galvanic Reaction	N	Neurotic Inventory Score	Average Per Cent Galvanic Reaction	N	Neurotic Inventory Score	Average Per Cent Galvanic Reaction
I	30	M F	10 5	7 16	9.69 10.26				10 5	11 12	12.42 4.38
		M and F	15	14	9.90				15	106	12.00
					A.D. 5.95						A.D. 3.06
II	21	M F	6 1	11 10	7.45 10.30	2 5	21 50	49.35 7.52	2 5	46 10	15.64 10.70
		M and F	7	91	8.30	7	41	23.60	7	107	12.10
					A.D. 3.93			A.D. 20.92			A.D. 11.29
III and IV	36	M. F.	6 6	3 14	11.88 11.17	6 6	19 94	7.08 22.90	3 5	71 10	7.89 4.02
		M. and F.	12	13	12.80	12	53	16.40	12	139	6.10
					A.D. 4.49			A.D. 3.73			A.D. 4.31

men and women. Data on fraternity or club membership and on intelligence test ratings are also given quintile by quintile. No consistent differences were observed for the number of gradepoints or the number of cases on probation in the various quintiles; and the data are, therefore, omitted.

This measure shows in Table 57 no consistent relation to the scores on the neurotic inventory, although the combined standard scores of groups I–II and III–IV give a low negative correlation of −.112 ± .073. Table 58 indicates that the "extroverts" of the Northwestern University Test tend to have larger reactions than the "introverts." The correlation, *r*, is .115 ± .085. In agreement with this latter observation is the fact that persons with large conditioned galvanic changes are most often fraternity or club members (see Table 56) and offer fewer specific instances of unsocial behavior[1] than those with small responses. There is also evidence of higher American Council Intelligence Test scores among persons with large conditioned reactions. The correlation, *r*, is .302 ± .112 in groups I–II and .262 ± .098 in groups III–IV. Persons with small conditioned reactions most often report getting tired of people, not making introductions, not being interested in people, and finding books more interesting than people. There are

TABLE 58

PER CENT GALVANIC REACTION TO THE CONDITIONED STIMULUS IN RELATION TO INTROVERSION-EXTROVERSION SCORES

This table shows a tendency for extroverts to give larger reactions than introverts.

[illegible]

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[1] As indicated by the histograms.

low correlations of −.137 ± .069 and −.121 ± .069 with composite scores on "socially inactive" and "neurasthenic" tendencies. The significance of these observations, especially in the light of the findings of Pavlov and others, may best be considered in the section on percentage of association of the conditioned with the conditioning stimuli. Golla (1921), Jones (1928), Slight (1929), and Freeman (1930) report interesting use of the conditioned galvanic reaction.

QUESTIONNAIRE ITEMS RELATING TO THE PER CENT GALVANIC REACTION TO THE CONDITIONED STIMULUS

$N = 93$ (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank − = No

QUESTIONS RELATIVE TO SOCIAL ORIENTATION

Do you take responsibility for introducing people at a party? 1–10
min. 1 + + . + . + , + , + , ? . ? , ? , ? , − . − − . − . − . − − , − , − ,

get tired of people quickly? 7–21
. 1 + + . + . + + , + , + , + , + , ? , ? , − .
2 + + . + + . + , + , + , + , ? , − − . − .

max. 5 + + , ? , − . − . − . − . − . − . − − − . − , − , − , − , − , − , −

Do you often get interested in people you meet? 8–17

Is your mother dissatisfied with her lot in life? 6–20

Do you mind having your friends see you in a 5 and 10 cent store? 7–13
min. 1 +.+.+,+,?.−.−.−.−.−.−.−.−,−,−,−,−,−,−,
2 +.+.+,+,+,?,− −.−,−.−.−,−.−.−,−,−,−,−,
3 +,?,−,−,−.− −.−.−.−,−,−,−,−,−,−,
4 +.+,?.−.−.−.−.−.−.−.−.−,−,−,−,−,−,−,−,
max. 5 −,−.−.−,−,−.−,− −.−,−,−,−,−,−,−,−,−,−,

Have you found books more interesting than people? 3–5
min. 1 +.+ +.+,+,+,+,+,+,?.?,−.−.−.−.−.−.−,−,
2 +.+.+ +,+,+,+,+,+,?.?,−.−.−,−.−,−.−,−,
3 + +,+,?.?.?,−.−.−.−.−.−.−.−,−,−,−,
4 +.+.+,+,+,?,?,−.− −.− − −.−.−,−,−,−,−,
max. 5 + + +,+,?.?.?,−.−.− −.−.−.−,−,−,−, −,−,

MISCELLANEOUS QUESTIONS

Do you get tired of amusements quickly? 3–26

4 +.+ +.+,+,?.?.?,?,−.−.−.−.−.−,−,−,−,−,
max. 5 +.+ + +,?.?,?,?, −.−.− .− −, −,−,−,−,

Are your daydreams usually about unpleasant things? 5–8
min. 1 −.−.− −.−.−.−.−.−.−.−,−,−,−,−,−,−,−,

Do you frequently feel that you deserve a better lot than you have? 7–4

max. 5 +,?.

Do you usually feel well and strong? 7–2

The relation of conditioned galvanic reactions to the conditioned blood-pressure reactions will be considered in the succeeding section and in Table 81 (p. 238).

17. BLOOD-PRESSURE CHANGE AFTER CONDITIONED STIMULI

The blood-pressure reactions to the conditioned stimuli, as evident in Table 59, show no correlation with the standardized shocks where double-intensity stimuli were employed, and a rather marked positive correlation of .527 ± .074 with the strength of shock where single intensity was used. The elimination of a single case brings this latter correlation down to .232 ± .098. It may be significant for our study of the differential blood-pressure and galvanic reaction to stimulation that the conditioned galvanic change, as shown in the preceding section, correlated with intensity only for strong conditioning stimuli, while here we find the correlation only for weaker conditioning stimuli. In both groups I–II and III–IV, as was true of the conditioned galvanic reaction, a positive relation appears between the blood-pressure change after the conditioned stimuli and the magnitude of the recorded arm movement attending the shocks. The correlation of the conditioned blood-pressure reactions with the conditioning blood-pressure responses would be remarkable only if it were low or negative.

TABLE 59

THE CORRELATION OF CONDITIONED BLOOD-PRESSURE REACTION WITH PHYSIOLOGICAL FACTORS IN C_1

Groups	Milliamperage of Standardized Shock	Recorded Arm Movement after Shocks	Recorded Blood-Pressure Reaction to Shocks
I–II	.002 ± .095	.162 ± .097	.261 ± .090
III–IV	.527 ± .074*	.306 ± .098	.655 ± .059

The ranges of the measures within the various quintiles are given in Table 60. There is a slight but not significant tendency for the women to show small or minus blood-pressure changes following the conditioned stimuli. The respective quintiles for this measure are not consistently related to averages for any of the data from the recorder's office save the American Council Intelligence Test scores. The magnitudes of the blood-pressure and

DATA ON THE BLOOD-PRESSU
REACTION TO CONDITIONED STIMULI

Groups	Quintiles	N	Range (Average Blood-Pressure Reaction)	Sex (Percentage of Men)	American Council Intelligence Test Score
I–II........	min. 1	10	−3.0 to −0.8	40.00	168.4
	2	10	−0.8 to 0.1	60.00	189.7
	3	10	0.2 to 0.5	50.00	182.7
	4	10	0.6 to 1.3	80.00	185.0
	max. 5	10	1.3 to 4.3	40.00	212.1
III–IV.	min. 1	9	−3.9 to −1.1	55.56	175.0
	2	9	−1.1 to −0.5	55.56	189.2
	3	7	−0.4 to −0.1	42.86	196.7
	4	9	0.1 to 0.7	77.78	200.1
	max. 5	9	0.8 to 7.7	66.67	212.8

PERSON   Y IT   -PRESSURE   D GALV
REAC   D CON   D STIMULI

This table shows a predominance of well-adjusted individuals in the groups with the largest galvanic combined with the smallest blood-pressure reactions to the conditioned stimuli. A high frequency of well-adjusted answers is indicated by the numbers in bold face type. + = yes. ? = question or blank. − = no.

SMALL GALVANIC REACTI

Small Blood | Large Blood

3-14 Can you sit still without fidgeting?. . . . .
4-25 Did you ever have a strong desire to run away f
home?. . . . .
5-20 Do you make friends easily?
6-25 Do you often feel just miserable?. . . . .
6-21 Do things often go wrong for you through no fault of your own?. . . . .
6-23 At a reception or tea do you seek to meet the important person present?. . . . .

galvanic changes relative to each other appear, on the average, about the same after these conditioned stimuli as after the non-conditioned clicks or the shocks. A comparison of the replies to the personality inventory made by the 12 individuals (6 from groups I–II and III–IV, respectively) representing in the highest degree the four possible combinations of $\frac{\text{large } (+)}{\text{small } (-)}$ blood-pressure reactions with $\frac{\text{large}}{\text{small}}$ galvanic changes shows a differentiation as to the meanings of the two measures for personality by the way these different groups answer the questions enumerated in Table 61. The outstanding consistency that appears in this table is that the individuals with the largest galvanic changes and the smallest blood-pressure reactions to the conditioned stimuli answer these questions in a manner suggesting a comfortable adjustment to life-situations.

QUESTIONNAIRE ITEMS RELATING TO THE BLOOD-PRESSURE RISE AFTER CONDITIONED STIMULI

$N = 93$ (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank – = No

QUESTIONS RELATIVE TO EMOTIONAL EXCITABILITY—ANXIETY

Do your feelings alternate between happiness and sadness without apparent reason? 3–22

min. 1 +.+ + +,+,?,?,–.– –.–.–.–.–.–,–,–,–,–,

Are you frequently worried about religion? 3–25

Does it make you uneasy to sit in a small room? 4–1
min. 1 +.+ +,+,?,−.−.−.−.−.−.−.−.−,−,−,−,−,−,

3 +.+
4 ?,−
max. 5 +.−

Questions Relative to Social Orientation

Did you get on well with your brothers and sisters? 1–27
min. 1 +.+,+.+,+.+.+.+.+.+,+,+,+,+,+,+,?.?,−,
2 +.+.+.+.+.+.+.+ +,+,+,?.?.?,?,?,?,?,−,
3 +.+.+.+.+.+,+,+,?.?.?.? ?,?,?,?,−,
4 +.+.+.+.+.+.+.+,+,+,+,+,?.?.?,?,?,?,−.
max. 5 +.+.+.+.+.+.+,+,+,+,?.?.?.?,?,−.−,−,−,

Do you make friends easily? 5–10

Questions Relative to Orientation toward Reality

Are your daydreams about improbable o

3 +.+
4 +.+
max. 5 +.+

Have you ever s

4 ?.-

As in the case of the galvanic response to the conditioned stimuli, persons showing the larger degree of blood-pressure conditioning (Table 60) tend to make the higher intelligence-test scores. The correlation, r, with intelligence is .414 ± .100 in groups

I–II, and is .177 ± .102 for groups III–IV. No consistent relation appears in Table 62 with introversion-extroversion scores.

AVERAGE BLOOD-PRESSURE REACTION TO THREE CONDITIONED CLICKS IN RELATION TO INTROVERSION-EXTROVERSION SCORES

This table shows no consistent tendency.

Group	Total N	Sex	Low Score (Introvert)			Medium Score			High Score (Extrovert)		
			N	Introversion-Extroversion Score	Average Blood-Pressure Reaction	N	Introversion-Extroversion Score	Average Blood-Pressure Reaction	N	Introversion-Extroversion Score	Average Blood-Pressure Reaction
I–II	22	M. F.	3 4	261 40 201	0.13 −0.08	2 3	309 00 155	0.50 0.73	4 3	357 10 142	0.00 0.87
		M. and F.	7		−0.04	5		0.55	7		0.35
					A.D. 0.66			A.D. 1.00			A.D. 0.93
III and IV	35	M. F.	7 5	304 50 307	−0.52 0.08	7 4	509 50 330	−0.42 1.30	5 7	650 40 605	0.06 −0.52
		M. and F.	12		−0.28	11		0.26	12		−0.29
					A.D. 0.96			A.D. 1.34			A.D. 0.58

Table 63 shows some tendency for the conditioned blood-pressure reactions to be largest for those with high scores on the neurotic inventory. The correlation with the combined standard scores is .211 ± .070, the probability, P, that this is attributable to chance being 1 in 20. The questions answered in a "neurotic" manner by persons with the larger reactions in both groups I–II and III–IV refer to such things as trouble with brothers and sisters, difficulty in making friends, improbable dreams, alternation of moods, and worry over religion. Relative to these answers, the questions about having seen a vision and uneasiness in a small room are apparently answered inconsistently. As an indication of the degree of consistency characterizing the various relationships, the correlations with the composite scores (pp. 219 ff.) follow.

The blood-pressure reaction to the conditioned stimuli correlates with composite scores on "socially inactive" tendencies .284 ± .064, the probability, *P*, that this is attributable to chance being 1 in 100. It also correlates with composite scores on "hypersensitivity" .228 ± .066, and on "depression" .205 ± .067, *P* here being 1 in 20. Correlations of .190 ± .067, .104 ± .067, and .182 ± .068 also occur, respectively, with composite scores on "anxiety," "paranoid" tendencies, and "disorientation to reality," *P* here being 1 in 10. Each of these correlations, it is to be noted, differs in a positive direction from those already reported for the blood-pressure reaction to the shocks. It will be observed that correlations with composite scores which gave minus values for

TABLE 63

REACTION TO THREE CONDITIONS

This table shows in groups I and III–IV a tendency toward greater positive blood-pressure change for the "neurotic" than for the "non-neurotic" subjects. There is an exception in the case of the men in group II.

the shocks have, in the case of the conditioned reaction, become zero or plus, and that correlations which were zero have become plus. As a result of conditioning, blood pressure has changed from a measure where a negative change correlated with neurasthenic tendencies and excitability, to one where rise in blood pressure correlates with "socially inactive" and "melancholic(?)" tendencies. The significance of the galvanic change under these same conditions, as previously indicated, appears quite different.

We may conclude consideration of the blood-pressure reaction to the conditioned stimuli by a reiteration of the fact that as a result of conditioning, the effect of stimulation on blood pressure has changed from a measure where a negative change accompanied "neurasthenic" tendencies and excitability, to one where a rise in blood pressure correlates with "socially inactive" and "melancholic" tendencies. These correlations are not sufficiently high to be of value for prediction in individual cases.

18. PERCENTAGE OF ASSOCIATION (?) OF THE GALVANIC REACTIONS TO THE CONDITIONED STIMULI (CLICKS) WITH THE CONDITIONING STIMULI (SHOCKS)

This is an attempt to measure the degree and permanence of conditioning by comparing the galvanic reactions to the clicks (the conditioned stimuli) with the reactions to the clicks plus the shocks (conditioning stimuli) immediately preceding. It is calculated as follows:

$$\frac{\begin{array}{c}\text{Average ohms change after three conditioned}\\ \text{pendulum clicks}\end{array}}{\begin{array}{c}\text{Average ohms change after three conditioning}\\ \text{electrical shocks preceding}\end{array}} \times 100 .$$

This measure shows no consistent relation to the strength of the shock or to the magnitude of the recorded arm movement. A relationship with sex appears in groups I–II (Table 64), men occurring with highest frequencies in the quintiles for the larger reactions; but no difference appears in groups III–IV. Since data are presented in the histograms only when similar regressions appear in both groups I–II and III–IV, sex is probably not a determining factor in the relationships presented by histogram. We may not be so sure to what extent it is a factor in some of the other correlations. The average intelligence test scores and grade-points for the first quarter are also presented quintile by quintile in Table 64 because both of these variables appear related to the percentage of association. No clear consistent relationship appeared with the number of students on probation or the frequency of fraternity or club membership, and the data are, therefore, omitted.

TABLE 64

Miscellaneous Data Relating to the Percentage of Association (P) of Clicks and Shocks

Groups	Quintiles	N	Range Percentage of Association(P)	Sex Percentage of Male	Intelligence Test Score	Grade-Points during First Quarter at University
I–II..........	min. 1	10	0.0 to 29.0	30.00	183.6	3.60
	2	10	30.0 to 51.2	50.00	184.2	3.20
	3	10	52.4 to 67.7	60.00	156.8	3.34
	4	10	68.2 to 85.3	60.00	198.7	2.83
	max. 5	10	86.4 to 122.8	80.00	205.0	3.86
III–IV........	min. 1	9	6.7 to 43.1	66.67	164.2	2.48
	2	9	44.2 to 60.0	55.56	190.0	2.67
	3	7	60.5 to 70.4	57.14	185.3	1.52
	4	9	71.8 to 82.3	55.56	210.6	2.80
	max. 5	9	84.8 to 172.3	55.56	212.2	3.48

A slight relation is shown in Table 65, notwithstanding the inconsistency of group I, between percentage of association and the neurotic inventory scores. The correlation for the combined standard scores of groups I–II and III–IV is −.107 ± .073. This might have occurred by chance once in 3 times. In Table 66 there is a slight tendency for extroverts to show the larger average percentage of association in groups II and III–IV. The correlation[1] for the combined standard scores is .126 ± .084, offering 2 chances in 5 of being a result of chance.

The highest correlation shown by this measure with any personality variable is with the composite scores on "neurasthenic" tendencies, the correlation being −.266 ± .065, and the probability, *P*, that it is attributable to chance is 1 in 100. A correlation of −.211 ± .067 occurs with "hyper-sensitivity," the probability,

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[1] The elimination of one subject reduces this correlation to .065 ± .086.

TABLE 65

PERCENTAGE OF ASSOCIATION (?) OF CLICKS WITH SHOCKS IN RELATION TO NEUROTIC INVENTORY SCORES

This table shows a tendency in groups II and III–IV for subjects having high scores on the neurotic inventory to have low percentage of association of click and shock.

Group	Total N	Sex	Low Score (Non-neurotic)			Medium Score			High Score (Neurotic)		
			N	Neurotic Inventory Score	Average Percentage of Association of Clicks with Shocks	N	Neurotic Inventory Score	Average Percentage of Association of Clicks with Shocks	N	Neurotic Inventory Score	Average Percentage of Association of Clicks with Shocks
I	30	M. F.	10 5	3 to 11	61.80 49.48				5 10	24 to 100	56.94 46.85
		M. and F.	15		55.09				15		58.05
					A.D. 25.94						A.D. 20.87
II	21	M. F.	6 1	11 to 21	75.58 67.70	2 5	25 to 42	80.45 43.38	2 5	45 to 117	66.45 33.00
		M. and F.	7		74.50	7		53.90	7		42.60
					A.D. 20.24			A.D. 31.54			A.D. 25.49
III and IV	36	M. F.	6 6	4 to 31	56.77 60.45	6 6	26 to 53	65.08 61.60	7 5	78 to 174	51.50 65.50
		M. and F.	12		60.06	12		62.04	12		57.86
					A.D. 16.61			A.D. 10.66			A.D. 28.83

P, being 1 in 20. Other correlations of −.181 ± .068 and −.172 ± .068 are obtained, respectively, with "socially inactive" tendencies and with "anxiety," *P* being 1 in 10. Correlations of −.166 ± .068 and −.135 ± .069 with probabilities of 1 in 5 occur also with "depression" and "excitability." The correlations with intelligence suggested by the averages of Table 64 are .235 ± .115 and .300 ± .096 in groups I–II and III–IV, respectively.

TABLE 66

Percentage of Association (?) of Clicks with Shocks in Relation to Introversion-Extroversion Scores

This table shows a slight tendency for extroverts to have the larger percentage of association of the clicks and the shocks.

Group	Total N	Sex	Low Score (Introvert)			Medium Score			High Score (Extrovert)		
			N	Introversion-Extroversion Score	Percentage of Association of Clicks with Shocks	N	Introversion-Extroversion Score	Percentage of Association of Clicks with Shocks	N	Introversion-Extroversion Score	Percentage of Association of Clicks with Shocks
II	21	M F	3 4	363 60	80.43 42.85	3 4	509 60	69.81 30.44	4 3	557 10	74.80 53.33
		M. and F.	7	403	58.94	7	551	47.36	7	143	64.60
					A.D. 31.94			A.D. 29.54			A.D. 29.70
III and IV	35	M F	7 5	364 90	45.54 64.45	7 4	509 60	70.40 72.21	5 7	596 60	61.36 59.00
		M. and F.	12	503	53.43	11	558	74.34	12	663	60.39
					A.D. 25.93			A.D. 18.34			A.D. 29.32

Questionnaire Items Relating to the Percentage of Association (?) of Clicks with Shocks

$N = 93$ (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank – = No

Questions Relative to General Health

POOR HEALTH RELATED TO SMALL PERCENTAGE OF ASSOCIATION

Does your heart sometimes sound in your ears so that you cannot sleep? 1–9

max. 5 +, ?, –, – –, – –, – –, – –, –, –, –, –,

Have you ever had a nervous breakdown? 2–13

min. 1 +, +, +, ?, –, –, –, –, –, –, –, –, +, –, –, –, –, Are you frequently bothered with indigestion? 3–6

Do you have a great many bad headaches? 4–10

max. 5 ?,–.–.–.– –.–.– – – –.–,–;–,–,–,–,–,–,

Do you ever feel an awful pressure in or about the head? 3–9

Did you ever have anemia badly? 8–6

3 + +.?.–
4 +.? ?.–
t. 5 ? –.– –

EXCEPTIONS: ILL HEALTH (?) RELATED TO LARGE
PERCENTAGE OF ASSOCIATION

Did you ever have heart trouble? 4–30

max. 5 +.+ + +,+,+,?,–.–.–.–.–.–.–.–,–,–,–,–,–,

Has any of your family been insane, epileptic, or feeble-minded? 5–7

QUESTIONS RELATIVE TO SOCIAL ORIENTATION

Do you allow people to crowd ahead in line? 4–28

min. 1 +.+.+.+.+,+,+,+,+,?.?.?,?,−.−.−.−.−,−,
2 +.+.+.+.+,+,+,?.?.?.?,?,−.−.−.−,−,−,−,
3 +.+.+.+,+,?,?,−.−.−.−.−.−.−.−,−,−,
4 +.+.+,+,+,?.?.?.?.?,−.−.−.−.−,−,−,−,−,
max. 5 +.+.+,?.?.?,?,−.−.−.−.−.−.−,−,−,−,−,−,

At a reception or tea do you seek to meet the important person present? 6–23

min. 1 +.+,?.?,?,−.−.−.−.−.−.−.−.−,−,−,−,−,−,
2 +.+,+,+,+,?.?.?,?,−.−.−.−.−.−.−.−,−,−,

max. 5

Do you feel that you are not satisfactorily adjusted to life? 7–14

min. 1 +.+.+,+,+,+,+,+,?.?,?.−.−.−.−.−.−.−.−,
2 +.+.+.+.+,?,−.−.−.−.−.−.−,−,−,−,−,−,−,
3 +.+.+.+.+,?,−.−.−.−.−.−,−,−,−,−,
4 +.+.+.+.+,+,+,−.−.−.−.−.−.−.−,−,−,−,−,
max. 5 +.+,?.?,?,−.−.−.−.−.−.−.−.−,−,−,−,−,−,

Do you find it difficult to speak in public? 7–27

2 +.+.+.+,+,+,?.?,?,−.−.−.−.−.−.−,−,−,
3 +.+.+.+,?.?,?,−.−.−.−.−.−.−,−,−,−,

Do you frequently feel that you deserve a better lot than you have? 7–4

min. 1 +.+.+.+.+,+,?,?,−.−.−.−.−.−.−,−,−,−,−,

3 +.+.+,?.?,−.−.−.−.−.−.−
4 +,−.−.−.−.−.−.−.−.−.−.−
x. 5 +,?.?.−.−.−.−.−.−.−.−.−

Do you dislike to write about yourself even to very close friends? 7–15

min. 1 +.+.+.+.+,+,+,+,+,+,−.−.−.−.−.−.−,−,−,
2 +.+.+,+,+,?.?,−.−.−.−.−.−.−.−,−,−,−,−,

Have your employers generally treated you right? 5–21

min. 1 +,+.+,+.+,+ +,+,+,+,+,+,+,?.?,?,?,−.−,
2 +.+.+.+.+.+.+.+.+,+,+,+,+,?.?.?.?,?,?.
3 +.+,+.+.+.+.+,+,+,+,+,+,+,?.?.?.?.
4 +.+.+.+.+,+,+,+,+.+,+,+,+,+,+,+,?.?,?,

Can you stand critic without feeling hurt? 5–3

min. 1 +.+ +.· +,+,+,+,?.?.?.−.−.−,−,−,−
+,+,+,?.?.?.?,?,−.− −.−,−
+.+.+.+,+,+,+,+,?.?,−.−,
+,+,+,+,+,+,?.?,?,−.−,−.−
max. 5 + + +.+.+.+ +,+,+, ·,? ?

Do you make friends easily? 5–20

Was your mother the dominant member of your family? 7–28

max. 5 +

Questions Relative to Emotion

Are you afraid of falling when you are on a high place? 2–10

min. 1 +.+.+.+.+.+,+,+,+,+,?.−.−.−.−.−,−,−,−,
2 +.+,+,+,+,+,+,?,?,−,−,−,−,−,−,−,−,−,−,

Are you easily shocked by sexual topics, *risqué* stories, and the like? 3–1

min. 1 +.+,+,?,?,−.−.−.−,−,−,−,−,−,−,−,−,−,−,

4 +.−.−
max. 5 +,−.−

Do you have a great fear of fire? 5–19
min. 1 +.+.+,+,+,?.−.−.−.−.−.−.

Are you often in a state of excitement? 6–9

Can you stand the sight of blood? 6–14

Are you easily moved to tears? 4–27
min. 1 +.+.+ + +,+,+,− − −.−
2 + +.+.+ +,+.+.. .−.−.−.
3 +.+ +,+,+,? ?.− - −.−

Can you stand disgusting smells? 3–19

Are your feelings easily hurt? 2–14
min. 1 +.+.+ + + +,+,+,+,+,?.
2 +.+.+ + +.+,+,− − − −
3 + +.+.?.?.?,−.− −.−.−..
4 +.+.+ +.+ +,+,?.?.−.−..
max. 5 +.+.+,?,?,− −.− − − −..
Do you get discouraged easily? 4–16
min. 1 +.+.+ +,+,+,+,+,?,−.−.
2 + + +,+,+,+,?,−,−,−,−.
3 +.+.+.+,+,?.−.−.−.−.−.
4 +.+.+.+.+,?.−.−.−.−.−.
max. 5 +.+,+,?,?.−.−,−,−,−.−.

Do you often feel just miserable? 6–25

max. 5 +,+,+,−.−.−.−.−.−.−.−.−.−.−,−,−,−,−,−,

Do you have ups and downs in mood without apparent cause? 8–24

max. 5 +.+,+.? ?,−.−,−,−.−,− −,− −,−,−,−,−,−,

Do you often feel lonesome, even when you are with other people? 2–7
min. 1 + + +,+,+,+,+,+,+,+,?. ?.−.−.−,−.−.−,−,

max. 4 +.+,+.+,?,−.−.−.−.−.−.−.−

Do you often experience periods of lonelin
min. 1 +.+ +.+ +,+,+,+,+,+,−.−.−.−.−.−.−,−,−,
2 + +.+.+.+.+,+,+,−.−.−,−.−,−,−,−,−,−.−,
3 +.+.+ +.+,+,? −.−.−.−.− −,−,−,−,−,
4 +.+.+.+ +,+,+,+,−.−.−.−.−.−.−,−,−,−,−,
max. 5 + +.+,+,+,−.− −.−. ,−,− −.−,−,−,−,−,−,

MISCELLANEOUS QUESTIONS

Do you often say things on the spur of the moment and then regret them? 4–17

Do your interests change quickly? 4–21
min. 1 +.+.+.+.+.+,+,+,+,+,+,+
2 +,+.?,? ?,?,−,−.−,−.−.−

max. 5 +.+,+,? ?.?,−,−,−.−.−.−.−.−,−,−,−,−,−,

A small percentage of association such as that here showing relationship to certain specific "neurotic" tendencies might possibly be attributed to one or more of the following:

1. A small degree of conditioning of the indifferent stimulus.
2. An excessive reaction to the shocks, with great relief at their cessation.
3. Inhibition (possibly of cerebral origin).
4. Physiological exhaustion with fatigue of the affector (glandular?) or central (neural) mechanisms.
5. Deficient "psychic energy."

The fact that evidences of emotional excitability, such as ease of being shocked by sexual topics, fear of falling, fear of fire, frequent excitement, easily hurt feelings, easy discouragement, etc., are found in cases where there are small reactions to the conditioned clicks as compared with the reactions to the clicks plus the shocks, preceding, may mean that the reaction to the shocks has been excessive and that the effect of the conditioned stimulus was small because of the subject's great relief after cessation of the shocks. Numerous evidences of ill health in this group, such as the heart sounding in the ears, previous nervous breakdown, indigestion, headaches, and anemia, suggest a physiological subnormality which would favor explanation by assuming an easy exhaustion of the reactive mechanisms. Evidences of a tendency for the individual to withdraw from contact with his environment, on the other hand, might be thought of as functions of some central "inhibitory" process, or as due to general physiological subnormality. Richter (1930) offers evidence from the profuse sweating which follows several days after transections of the cord that the "cerebral control of the autonomic activity in the cord is predominantly an inhibitory one." Permitting people to crowd ahead in line, not meeting important persons at a tea, difficulty in public speech, and difficulty in making friends might suggest any of the three explanations—inhibition, physiological subnormality, or deficient "psychic energy." The lower average intelligence-test scores and number of grade-points achieved by the individuals with a low percentage of association may also be explained on any one of the three hypotheses.

The basis for explanatory concepts such as inhibition, repression, suppression, etc., which are invoked to account for emotional disturbances is, it must be admitted, highly inferential. In the absence of clear-cut experimental demonstration, however, we should not be disrespectful of any hypothesis which seems to fit the facts. Even such efforts at experimental study of the genesis of emotions as Watson's investigation of the rise of affective reactions in infants do not illuminate our problem. In fact, we would have expected, on the basis of Watson's observations, that the persons with the most frequent emotional disturbances would be those who were most readily emotionally conditioned to noxious stimuli. On the contrary, we find here the persons with the least, not those with the greatest, conditioning emotionally most unstable.

It must be borne in mind, however, that we are concerned here not with a skeletal but with a visceral mechanism. We are dealing with mechanisms of organic preparation, mobilization of energy, and of defense against effects of high temperatures, etc. (in the sense that the electrical changes appear to be functions of the heat-regulating mechanisms). From the standpoint of efficient function we might assume, without doing violence to known facts, that the person whose heat-regulatory organism automatically responded to conditioned sensory stimuli would be best equipped to meet life-situations—and that he might, also, be more stable emotionally. Indeed, it may well be that there is an intrinsic incompatibility between *emotional* excitability and facility of lower-level conditioning. Whether to attribute this to phenomena of diffuse irradiation due to emotion, to inhibition, or to something else, it may now be futile to guess; nevertheless, it may be that such an incompatibility exists and that what we term "neurosis" is essentially such a state. The results obtained by Slight (1929), with the exception of those from one subject, indicate a greater conditioning of the associated stimulus in the emotionally more stable individuals. Unstable individuals tended to be more indiscriminate in their reactions. Pavlov (1928) reported the deleterious effect of the emotional upset from a flood which swept his laboratory, upon the facility of forming conditioned salivary reactions in dogs. In like manner a neurosis occasioned by presenting a problem beyond the discriminative capacity of the animals was followed by prolonged refractiveness to all conditioning. Liddell and Bayne (1927) have reported similar results in the case of sheep.

The smaller average intelligence test scores and the fewer grade-points made by persons with the smaller percentage of association might be explained as a result of emotional difficulty or as due to the before-mentioned inhibition, physiological subnormality, or deficient "psychic energy."

In concluding discussion of these data, we may call attention to the fact that this measure is positively related to intelligence and affords some of our best correlations (negative) with "neurasthenic" and "emotionally unstable" tendencies. These are not sufficiently high to justify use of this measure for prediction in individual cases.

19. EXTINCTION OF THE CONDITIONED GALVANIC REACTION

The percentage of extinction of the conditioned reaction is calculated by subtracting from 100 per cent the percentage which the reaction to the third conditioned click is of the reaction to the first, as follows:

$$100\text{ per cent} - \frac{\text{Resistance change in ohms after third conditioned click}}{\text{Resistance c[illegible] ohms after first c[illegible]oned click}} \times 100\ .$$

This index of extinction shows no evidence of a correlation with the intensity of the shock or with the amount of recorded or rated arm movement.

TABLE 67

[illegible] OF REACTION T[illegible] E CON[illegible] D STIMULI

Groups	Quintiles	N	Range (Percentage of Extinction)	Sex (Percentage of Men)	Percentage Having Fraternity or Club Membership
I–II.......	min. 1	10	−150.0 to 0.0	50.00	40.00
	2	10	0.0 to 23.1	70.00	50.00
	3	8	23.5 to 42.9	62.50	25.00
	4	10	44.4 to 73.3	70.00	20.00
	max. 5	10	73.8 to 100.0	10.00	10.00
III–IV.....	min. 1	9	−240.0 to −22.2	55.56	44.44
	2	9	−20.0 to 26.5	55.56	33.33
	3	5	28.0 to 36.4	60.00	40.00
	4	9	36.8 to 72.5	66.67	33.33
	max. 5	9	80.5 to 100.0	66.67	11.11

The ranges within the respective quintiles on this measure are presented in Table 67. Since the women show, on the average, more extinction than the men in groups I–II and less than the men in groups III–IV, the combined simultaneous regressions presented in these pages are probably not to be attributed primarily to sex differences. A higher frequency of fraternity or club membership among individuals with the least extinction is also evident in this table. No consistent differences were observed in the quintile averages for intelligence test scores, cases on probation, or grade-points made during the first quarter; and the data are omitted.

QUESTIONNAIRE ITEMS RELATING TO THE EXTINCTION OF THE CONDITIONED GALVANIC REACTION

N = 89 (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank – = No

QUESTION RELATIVE TO SOCIAL ORIENTATION

Are you careful not to say things to hurt people's feelings? 2–3

Were your parents partial to any of your brothers and sisters? 5–6

max. 5

Did you ever

max. 5 + +.• +,•,+,·· .–.–.–.–.–,–,–,–,

Do you like to be by yourself a great deal? 4–26

Do you allow people to crowd ahead in line? 4–28

min. 1 +.+.+,?.?.?.?,?,−.−.−.−.−.−,−,−,−,−,−,
2 +.+.+,+,?.?.?.?,?,?,−.−.− −.− −,−,−,−,
3 +.+,+.+,+,+,+,?.−.−.−.−,−,
4 +.+.+.+,+,?.?,?,−.−.−.−.−.−.−,−,−,−,−,

Do you have difficulty in making friends? 5–4

min. 1 +.+,?,[illegible],−,−,−,−,−,−,
2 +.+,+.+,+,?.?.?,−.− −.−.−.−,−,−,
3 +.+.+.?.?,?,−.−.−.−.−,−,−,

At a reception or tea do you seek to meet the important person present? 6–23

max. 5 +.+.+,+,+,?.?.−.−.−.−.−.−.−,−,−,−,−,−

Do you love your mother more than your father? 6–32

Do you find it difficult to speak in public? 7–27

min. 1 +.+.+,+,?.?,−.− −.−.−.−.− −,−,−,

Were you considered a bad boy (or girl)? 8–23

min. 1 −.[illegible].−.−,−,−,−,−,−
2 +,?,?,−,−,−.−.−.−.−.−.−.−,−,−,−
3 ?,?,−.−.−.−.−.−.−.−.−,−,−,
4 +,−.−.−.−.−.−.−.−.−.−.−,−,−,−,−
max. 5 +,+.+,+,?,?,−,−.−.−,−.−.−.−.−,−

QUESTIONS RELATIVE TO EMOTION

Do you worry too long over humiliating experiences? 2–2
min. 1 +,+.+.+,+,+,?.?,?,–.–.–.–,–.–,–,–,–,–,

max. 5 +.+.+.+.+.+,+,+,+,+,+,+,+,?,–.–.–.–.–.

Do you have a great fear of fire? 5–19
min. 1 +.–.–.–,–,–.–,–,–,–,–,–,–,–,–,–,–,–,–
2 +.+,?,–.–.–.–.–.–.–.–.–.–,–,–,–,–,–,–.
3 +.+,–.– –,–.–.–,–,–,–,–,–,
4 +.+.–.–.–.–,–,–.–.–,–,–,–,–,–,–,–,–,–
max. 5 +.+.+,+,?.–.–.–.–.–.–.–.–,–,–,–,–,–,–:

QUESTIONS RELATIVE TO HEALTH

Did you ever have anemia badly? 8–6
min. 1 ?.–.–.–.–.–.–.–.–.–.–,–,–,–,–,–,–,–,–.
2 +,?.?.–.–.– –.–.– –.–,–,–,–,–,–,–,–,–

4 ? –.–.–.–.–.–.– –.–.–,–,–,–,–
max. 5 + + +,?,–,–.–.– –.–.–.– –,–,–

Is your head likely to ache on one side? 6–28

MISCELLANEOUS QUESTIONS

Have you ever felt as if someone were hypnotizing you and making you act against your will? 5–2

Do things often go wrong for you by no fault of your own? 6–21
min. 1 +.+,+,?,?,?,– –.–.–,–.–.– –,–.–,–,–,–,
2 +,+.+,?,–.–.–.–.–.–.–.–.–,–,–,–,–,–,–,

No consistent relation appears in Tables 68 and 69 between extinction of the reaction and total scores on the neurotic inventory or the introversion-extroversion test. There is, however, with the combined total scores for introversion-extroversion a correlation of $-.145 \pm .086$, which disappears with the elimination of one case. The highest correlation with any of the composite scores occurs with "somasthenic" tendencies, where $r = .146 \pm .070$ and where the probability that it is chance is 1 in 5. A correlation of $.100 \pm .071$ also occurs with "neurasthenic" tendencies.

TABLE 68

PERCENTAGE OF EXTINCTION OF REACTION TO THE CONDITIONED STIMULI IN RELATION TO NEUROTIC INVENTORY SCORES

This table shows no consistent relation between extinction and scores on the neurotic inventory.

Group	Total N	Sex	Low Score (Non-neurotic)			Medium Score			High Score (Neurotic)		
			N	Neurotic Inventory Score	Percentage of Extinction of Reaction to Conditioned Stimuli	N	Neurotic Inventory Score	Percentage of Extinction of Reaction to Conditioned Stimuli	N	Neurotic Inventory Score	Percentage of Extinction of Reaction to Conditioned Stimuli
I	30	M.	10	3	31.58				7	31	18.36
		F.	5	40	36.00				8	16	33.38
		M. and F.	15	24	33.72				15	296	22.92
					A.D. 39.78						A.D. 50.97
II.	29	M.	5	11	24.26	9	81	31.65	1	45	7.20
		F.	1	80	41.90	8	19	48.50	5	10	50.45
		M. and F.	6	41	27.46	17	47	38.52	6	147	45.55
					A.D. 25.83			A.D. 45.76			A.D. 38.72
III and IV . . .	35	M.	5	5	20.42	6	16	51.58	7	55	41.00
		F.	6	00	−30.48	6	00	20.17	5	14	52.00
		M. and F.	11	12	−5.35	12	32	32.57	12	120	48.41
					A.D. 61.84			A.D. 38.68			A.D. 63.54

Extinction may here be another result of some one or more of the following: (1) overreaction to the shocks with exhaustion of the reaction mechanism, (2) relief at the cessation of stimulation,

(3) physiological subnormality, (4) inhibition, or (5) psychological withdrawal from environmental contacts. The fact that practically the only correlation obtained with a composite score occurs with "somasthenic" tendencies is some argument favoring an influence of physiological subnormality. The evidence of socially inactive tendencies and emotional difficulties presented in the histograms must be inconsistent with the total data, for otherwise it is difficult to account for the failure to obtain correlations with the corresponding composite scores.

RELATION TO INTROVERSION-EXT

This table does not show consistent relationships.

Genus	Total N	Sex	Low Score (Introvert)			Medium Score			High Score (Extrovert)		
			N	Introversion-Extraversion Score	Percentage of Extinction of the Conditioned Action to Conditioned Stimuli	N	Introversion-Extraversion Score	Percentage of Extinction of the Conditioned Action to Conditioned Stimuli	N	Introversion-Extraversion Score	Percentage of Extinction of the Conditioned Action to Conditioned Stimuli
II . . .	19	M.	3	367	74.36	2	506	26.86	3	553	30.47
		F.	4	[illegible]	55.87	4	[illegible]	65.73	3	[illegible]	38.67
				299			554			544	
		M. and F.	7		38.00	6		45.80	6		36.07
					A.D. 36.77			A.D. 27.35			A.D. 35.43
III and IV . . .	34	M.	6	164	86.05	7	500	8.40	5	556	66.16
		F.	5	[illegible]	−22.70	4	[illegible]	35.95	7	[illegible]	9.86
				505			531			665	
		M. and F.	11		+.58	11		24.84	12		35.44
					A.D. 61.99			A.D. 41.56			A.D. 44.04

Pavlov (1928) and Froloff (1925), consistent with these findings, noted the rapid extinction characteristic of starving and thyroidectomized dogs. Kleitman and Crisler (1927) have observed similar effects of starvation on the salivary reflex conditioned to injections of morphine.

In concluding, we may refer once more to a low order correlation ($r = .146 \pm .070$) of extinction with "somasthenic" tendencies,

20. PERCENTAGE OF INCREASE IN RESISTANCE DURING TWO MINUTES OF REST AFTER STIMULATION

This measure is calculated as follows:

$$\frac{\text{Resistance change (in } \omega\text{) during 2 minutes of rest}}{\text{Resistance (in } \omega\text{) at beginning of rest}} \times 100 .$$

The increase in resistance during the 2 minutes of rest after stimulation shows no evidence of relationship to the strength of the shock or to the recorded or rated arm movement.

The ranges for the respective quintiles of groups I–II and III–IV are shown in Table 70.

TABLE 70

INCREASE IN RESISTANCE DURING 2 MINUTES OF REST AFTER STIMULATION

Groups	Quintiles	N	Range (Percentage of Resistance Change)	Sex (Percentage of Men)	American Council Intelligence Test Score
I–II . .	min. 1	10	−7.1 to 6.6	70.00	175.6
	2	10	8.0 to 10.9	50.00	185.8
	3	10	11.0 to 17.0	40.00	185.0
	4	10	18.3 to 32.5	30.00	187.8
	max. 5	10	32.8 to 61.2	40.00	198.4
III–IV.	min. 1	9	−28.8 to −0.9	77.78	190.0
	2	9	0.0 to 2.7	88.89	185.4
	3	7	3.2 to 5.9	14.28	168.0
	4	9	6.2 to 12.5	44.44	198.9
	max. 5	9	12.8 to 48.0	55.56	213.0

In both groups I–II and III–IV women show considerably greater tendency than men to fall in the quintiles for the larger increases in resistance during rest after stimulation, and it is quite probable that the differences and correlations discussed in this section are in part due to sex differences. It is interesting that Davis (1932) has likewise recently reported this sex difference in recovery during rest.

Individuals with the larger recovery during 2 minutes have higher average intelligence test scores than those with less recovery, r in groups I–II and III–IV being, respectively, .157±.100 and .136±.103. This finding agrees with the Thurstones' report of higher average scholarship among the more "neurotic" university students (Thurstone and Thurstone, 1930). No definite relation with fraternity membership, grade-points, or cases on probation is evident. The data in Table 72 show no consistent relation of this measure to scores on introversion-extroversion.

The data in Table 71 indicate that the subjects having high scores on the Thurstone Neurotic Inventory tend to recover

TABLE 71

INCREASED RESISTANCE DURING 2 MINUTES OF REST AFTER STIMULATION (FIRST SERIES) IN RELATION TO NEUROTIC
.r SCORES

This table shows a tendency for individuals having large "neurotic" scores to manifest the most rapid recovery after excitation.

Group	Total N	Sex	Low Score (Non-neurotic)			Medium Score			High Score (Neurotic)		
			N	Neurotic Inventory Score	Per Cent Galvanic Change	N	Neurotic Inventory Score	Per Cent Galvanic Change	N	Neurotic Inventory Score	Per Cent Galvanic Change
I	30	M. F.	10 5	1 10 24	12.89 56.40				7 8	71 50 100	13.90 21.10
		M. and F.	15		24.00 A.D. 19.80				15		18.50 A.D. 8.50
II	21	M. F.	4 3	12 10 22	9.57 31.50	2 5	43 10 42	35.35 16.83	2 5	45 10 111	20.70 32.36
		M. and F.	7		16.70 A.D. 8.71	7		28.10 A.D. 18.41	7		29.60 A.D. 12.57
III and IV . . .	36	M. F.	6 6	5 40 11	−4.05 10.95	6 6	26 40 55	9.35 13.65	7 5	73 50 119	9.05 7.36
		M. and F.	12		3.00 A.D. 10.71	12		11.40 A.D. 9.33	12		8.70 A.D. 7.41

rapidly during the period of rest. In groups I–II and III–IV the correlations between these measures are respectively .157 ± .100 and .136 ± .103. On the combined standard scores the correlation is .160 ± .072.

The highest correlation, .271 ± .065, appears with composite scores on "neurasthenic" tendencies. The probability, P, that this is attributable to chance is less than 1 in 100. The next highest correlation, .238±.066, is with "hyper-sensitivity" to personal affront. The probability that this is chance is about 1 in 50. In addition there are correlations of .197±.067, .188±.068, and

TABLE 72

INCREASED RESISTANCE DURING 2 MINUTES OF REST AFTER STIMULATION (FIRST SERIES) IN RELATION TO INTROVERSION-EXTROVERSION SCORES

This table shows no consistent relationship.

Group	Total N	Sex	Low Score (Introvert)			Medium Score			High Score (Extrovert)		
			N	Introversion-Extroversion Score	Per Cent Galvanic Change	N	Introversion-Extroversion Score	Per Cent Galvanic Change	N	Introversion-Extroversion Score	Per Cent Galvanic Change
II	21	M. F.	5 4	307 to 493	5.96 14.30	3 4	500 to 555	18.39 10.42	4 1	551 to 744	18.60 27.70
		M. and F.	9		12.10	7		20.80	5		21.80
					A.D. 4.70			A.D. 17.16			A.D. 11.68
III and IV	35	M. F.	7 5	304 to 497	8.80 14.90	7 4	500 to 551	5.60 38.66	5 7	550 to 665	5.80 0.60
		M. and F.	12		6.60	11		10.50	12		6.19
					A.D. 8.41			A.D. 21.74			A.D. [illegible]

.185±.068, respectively, with "anxiety," "excitability," and "sleep difficulties," P being here 1 in 10. There are also correlations of .169±.068 with "depression," and of .098±.069 with "socially inactive" tendencies. It is evident that the recovery during a period of rest after stimulation offers a measure somewhat better than any other we have used, for correlation with "neurasthenic" tendencies and with various other forms of "emotional instability."

QUESTIONNAIRE ITEMS RELATING TO INCREASED RESISTANCE DURING 2 MINUTES OF REST AFTER STIMULATION

$N = 93$ (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank – = No

QUESTIONS RELATIVE TO SLEEPLESSNESS AND FATIGUE

Does your heart sometimes sound in your ears so that you cannot sleep? 1–9

Do ideas often run through your head so that you cannot sleep? 3–3

3 + +
4 + +
5 +.+

lly feel fatigued when you wake up in th

Do you feel tired most of the time? 5–22
min. 1 + ?.?,–.– –.–.–.–.–.–.–.,

4 + +
max. 5 + +

Are you frequently troubled with nightmares? 6–33
min. 1 –.–.–.–.–,–.–.– –,–,–,–,–,–,–,–,–;–

Questions Relative to General Health

Are you troubled much by constipation? 1–5

min. 1 −.−.−.−.−.−.−.−.−.−.−,−,−,−,−,−,−,−,−,
2 +,−.−,−,−.−.−.−.−.−.−.−,−,−,−,−,−,−,−,
3 +,+,?.−.−.−.−.−.−.−.−.−.−,−,−,−,−,
4 +.+.+,+,?,−.−.−.−.−.−.−.−.−,−,−,−,−,−,
max. 5 +.+,+,+,−.−.−.−.−.−.−.−.−.−,−,−,−,−,−,

Do you find it necessary to watch your health carefully? 3–34

min. 1 +,+,?.−.−.−.−.−.−.−.−.−.−,−,−,−,−,−,−,
2 + +.+,+,?,−.−,−.−.−.−.−.−,−,−,−,−,−,−,
3 +.+.+,?.−,−.−.−.−.−.−.−,−,−,−,−,−,
4 +.+.+.+,+,+,?,−.−.−.−.−.−.−.−,−,−,−,−,

Do your eyes often pain you? 5–15

Have you been bothered by vomiting? 6–17

Do you sometimes have shooting pains in the head? 7–29

Do you often have queer unpleasant feelings in any part of your body? 7–31

Have you ever lost your memory for a time? 8–19
min. 1 −.−.−.−.−.−.−.−.−.−.−,−,−,−,−,−,−,

Questions Relative to Emotion

Do you get stage fright? 1–3
min. 1 +.+.+,?.?,−.−.−.−.−.−.−.−,−,−,−,−,−,−,
2 +.+.+.+,+,?,?,−.−.−.−.−.−.−.−,−,−,−,−,
3 +.+.+.+,+,+,+,?,−.−.−.−.−.−.−.−,−,
4 +.+.+ +.+,+,+,+,+,?,−,−,−.−,−.−,−,−,−,
max. 5 + +.+.+,+,+,+,?.?,?,−,−,−,−,−,−,−,−,−,

Do you worry too long over humiliating experiences? 2–2

Do you often get lonesome, even when you are with other people? 2–7
min. 1 +.+,+,?.−,−.−.−.−.−.−,−.−,−,−,−,−,−,−,

ax. 5

Are you afraid of falling when you are on a high place? 2–10
min. 1 +.+,+,?.?,?,−.−.−.−.−.−.−.−.−,−,−,−,−,
2 +.+.+.+,+,+,?.? −,−.−,−,−.−,−,−,−,−,−,−,
3 +.+.+.+,+,?,?,−,− −.−,−,−,−,−,−,−,

ax. 5

Are you frequently burdened by a sense of remorse? 3–11

Do you get rattled easily? 3–18

min. 1 +.?.–.–.–.–.–.–.–.–,–,–,–,–,–,–,–,
2 + +,+,?,?,?,· .–.– –.–.–,–.–, –,–,–,..,–,
3 +.+,+,?,?,–.–.–.–.–.–.–.–.–.–,–,–,
4 +.+.+ +,+,?.–.–.–.–.– –.–.–,–,–,–,–,–,
max. 5 + +.+.+.+ +.+,+,+,–.–.–.–.–,–,–,–, ,–,

Are you often frightened in the middle of the night? 3–35

Have you ever been afraid that you might jump off when you were on a high place? 4–13

max. 5 +.+ +,+ +.+ +.+,? – –.

Do you get discouraged easily? 4–16

Are you easily moved to tears? 4–17

Does criticism disturb you badly? 7–18

min. 1 +,?.–.– –.– –.–.–.–.–.–,–,–,–,–,..,–
2 +.+.+.+,?.?.–.–.–.–.–.–,–,–,–,–,–,–
3 +.+.+.+.+,+,?,–.–.–.–.–.–.–,–,–,–.
4 +.+ +,– –. · –. .–. .–. ,–,–,–,–,–,–
max. 5 +,+.+.+.+,+,?,–.–,–.–.–.–.–,–.–,–,–

Were you happy when fourteen to eighteen years old? 5–10

min. 1 +.+.+.+.+.+.+.+.+.+,+,+,+,+,+,+,?.?,–,
2 +.+.+.+.+,+.+,+,+,+,+,+,+,+,+,+,?.–,–,
3 +.+.+.+.+.+.+,+,+,+,+,+,?.?.–.–.–,
4 +,+,+,+,+,+,+,+,+,+,+,?.?,?,–,–.–,–,–,
max. 5 +.+.+.+.+.+.+.+,+,+,+,+,+,?.–.–.–,–,–,

QUESTIONS RELATIVE TO SOCIAL ORIENTATION

Do you keep in the background on social occasions? 3–2

min. 1 +.+.+,?.?,–.–.–.–.–.–.–.–,–,–,–,–,–,–,
2 +.+.+.+,+,+,?.?,?,–,–,–.–,–,–,–,–,–,–,
3 +.+.+.+.+.+.+,+,?.?,?,–.–.–.–,–,–,
4 + +.+ +,+,+,+,+,+,–.–.–.–,–,–,–,–,–,–,
max. 5 +.+.+.+.+.+,+,?.?.?,?,?,–.–.–.–,–,–,–,

Does it bother you to have people watch you at work even when you do it well? 4–31

min. 1 +,+,+,+,+,–.–,–,–.–.–.–.–,–,–,–,–,–,–,

4 +.+.+.+,+,+,+,+,?.?,?,–,–.–.–.–.–,–,–.
max. 5 +.+.+.+.+,+,+,+,+,+,+,?.?,–.–,–.–.–,–,

Do you feel self-conscious when you recite in class? 6–18

3 +.+.+.+.+.+.+,?.–.–.–.–.–,–
4 +.+ +.+.+.+,+,+,+,+,–.–.–.–
max. 5 + +.+ +,+,+,?.?,?,– –.– –.–

Were your parents happily married? 5–27

Do you feel self-conscious in the presence of your superiors? 7–21

min. 1 +,+.+,+,+,+,–.–.–.–,–.–,–.–,–,–,–,–,–, Do you often get interested in people you meet? 8–17

min. 1 ◆.+ ◆.+.+ ◆.+ ◆,+,◆,+,+,+,+,?,−.−.−.−,

MISCELLANEOUS QUESTIONS

Do you have the habit of leaving a lot of tasks unfinished? 3–4

Do you often find that you
action has passed? 8–10

◆ ◆ ◆

An attempt to evaluate this rise in resistance in the light of these facts requires a brief consideration of the possible significance of such a measure.

An increase in resistance during the period of rest after stimulation might conceivably be a function:

1. Of the efficiency of the gradual recuperative mechanisms of the body.
2. Of the inefficiency of the recuperative processes immediately after reaction, possibly with attending physiological exhaustion.
3. Of excessive reaction to the preceding stimuli, with physiological or psychological relief at their cessation.
4. Of the subject's tendency to withdraw from contact with his environment.

The many evidences of fatigue and ill health reported in the histograms by individuals with rapid rise in resistance during rest argue against the first possibility—that large values in this measure are associated with efficiency of the recuperative mechanisms. It rather suggests the second, i.e., that the large rise is due to an insufficiency of the immediate recuperative changes following excitation, thus delaying recovery until the end of stimulation. It may be recalled that our previous consideration of the galvanic recovery during 3 seconds after reaction showed a negative correlation with "somasthenic" tendencies, which, as far as it goes, is consistent with possibility No. 2. In this connection Richter's (1929) observation of an excessive tendency toward a rapid rise in resistance in narcoleptic patients is of significance.

On the other hand, the numerous indications of emotional instability, such as "neurasthenic" tendencies, "hyper-sensitivity," depression, anxiety, and excitability, among persons with large resistance-rise in 2 minutes would favor view No. 3, that we have here evidence of excessive reaction to stimulation, with tension or anxiety during the intervals between shocks, and with great physiological or psychological relief at cessation of the stimuli. Persons with small immediate galvanic recovery during 3 seconds after reaction, it may be recalled, also reported certain "neurasthenic" tendencies, and various forms of flight from social contacts, facts which might be contributory to a large delayed recovery.

Hypothesis No. 4, in the light of the apparent relation of this measure to emotional instability, can mean little more than the statement that after excitement individuals tend to become less excited.

In conclusion of the discussion of this measure, we may reiterate the earlier statement that we have in the percentage of recovery during 2 minutes of rest after stimulation a measure giving a somewhat higher correlation than any other we have used with "neurasthenic" tendencies and various other forms of "emotional instability." The correlation is not, however, sufficiently high for the measure to be of value for prediction in individual cases.

21. THE MAGNITUDE OF THE RECORDED ARM MOVEMENT AFTER THE SHOCKS

The arm movement, indicated by the millimeters of deflection of a pointer on the record, is a rough indicator of the movement or the tensing of the subject's right arm in response to the electric shock. The pointer is deflected by a bellows connected by air conduction to a blood-pressure cuff inflated to 30 mm. Hg. on the biceps of the right arm. Differences in the size of the arms of the various subjects, and differences in their muscular development, etc., are, of course, uncontrolled factors in such a measure. Nevertheless, the combined data from numbers of subjects show interesting, and probably significant, relationships to other data.

The ranges of recorded movement within the respective quintiles of groups I–II and III–IV are indicated in Table 73. The

TABLE 73

Recorded Arm Movement

Groups	Quintiles	N	Range (Millimeters of Recorded Movement)	Sex (Percentage of Men)	Grade-Points during First Quarter at University
I–II........	min. 1	9	0.00 to 3.07	55.56	3.47
	2	9	3.60 to 9.55	44.44	3.50
	3	9	9.87 to 14.07	44.44	3.60
	4	9	15.57 to 22.33	55.56	3.06
	max. 5	9	23.10 to 33.00	55.56	3.07
III–IV.....	min. 1	8	0.00 to 0.87	62.50	3.62
	2	8	0.10 to 1.00	50.00	3.59
	3	7	2.53 to 4.87	57.14	2.81
	4	8	5.00 to 8.53	75.00	1.50
	max. 5	8	8.57 to 21.33	37.50	2.10

ranges are somewhat higher in groups I–II, owing probably to the double-strength shock which was administered. No clear differentiation of the men and women as regards the magnitude of the arm movement is indicated. There is some evidence that persons in the quintiles with the least arm movement make slightly the highest average number of grade-points. No relation appears with intelligence test scores, fraternity membership, or the number of cases on probation for scholastic deficiencies.

A relation of the amount of recorded arm movement to the strength of the standardized shocks is evident in Table 74 in both groups I–II and III–IV, the correlations, *r*, being .270±.093 and .205±.104, respectively. The elimination of one case in groups III–IV with the single-intensity shocks brings the correlation down to −.107 ± .108. This positive correlation in groups I–II confirms our impression from watching the subjects' motor reactions during the tests, that the stimuli of double the standard intensity were not necessarily equivalent. The fact that, after eliminating one case, a negative and negligible correlation appears in groups III–IV is some evidence of the excitatory equivalence of the standardized stimuli under the modified conditions. It is also interesting (Table 74) that in the case of the single-intensity shocks, the arm movement record correlates positively with the galvanic reactions, although the galvanic change (p. 121) showed no relationship to the strength of the shock.

CORRELATIONS OF ARM MOVEMENT WITH OTHER PHYSIOLOGICAL MEASURES

	Groups I–II	Groups III–IV
Correlations, *r*, of arm movement following shock with other simultaneous conditions:		
Milliamperage of standard shock	.270 ± .093	.205 ± .104* (− .107 ± .108)
Voltage of standard A.C. shock	No data	−.074 ± .132
A.C. initial resistance of stimulating electrodes	No data	.127 ± .130
Galvanic reaction to shock	.117 ± .098	.284 ± .090
Blood-pressure reaction to shock	.066 ± .100	.246 ± .102
Correlations, *r*, of arm movement following shock with non-simultaneous indexes of reactivity:		
Initial resistance	−.266 ± .092	−.228 ± .105
Minimum resistance	−.328 ± .089	−.389 ± .094
Total resistance change	.206 ± .095	.188 ± .107
Spontaneous galvanic reactions between shocks	.326 ± .090	.446 ± .086
Galvanic recovery 3 seconds following peak	.337 ± .097	.447 ± .088
Galvanic reaction to the conditioned stimulus	.219 ± .095	.283 ± .099
Blood-pressure reaction to the conditioned stimulus	.162 ± .097	.306 ± .098

TABLE 75

RECORDED ARM MOVEMENT IN RELATION TO NEUROTIC INVENTORY SCORES

This table shows no consistent relation between the amount of recorded arm movement and scores on the neurotic inventory.

Group	Total N	Sex	Low Scores (Non-neurotic)			Medium Scores			High Scores (Neurotic)		
			N	Neurotic Inventory Score	Recorded Arm Movement (mm. deflection)	N	Neurotic Inventory Score	Recorded Arm Movement (mm. deflection)	N	Neurotic Inventory Score	Recorded Arm Movement (mm. deflection)
I	27	M. F.	9 5	5 10 14	11.49 4.40				2 11	75 40 100	17.32 13.48
		M. and F.	14		12.82				13		14.91
II	17	M. F.	5 1	11 10 38	20.58 2.97	1 5	81 16 42	8.00 10.15	1 4	85 1 103	0.64 14.08
		M. and F.	6		17.49	6		9.74	5		10.41
III and IV . . .	32	M. F.	5 6	5 10 18	4.25 5.88	5 6	16 10 37	9.54 5.85	6 5	75 10 130	8.40 5.51
		M. and F.	11		4.96	11		6.12	10		3.95

TABLE 76

RECORDED ARM MOVEMENT IN RELATION TO INTROVERSION-EXTROVERSION SCORES

This table shows no consistent relation between introversion-extroversion scores and the amount of recorded arm movement.

Group	Total N	Sex	Low Scores (Introvert)			Medium Scores			High Scores (Extrovert)		
			N	Introversion-Extroversion Score	Recorded Arm Movement (mm. deflection)	N	Introversion-Extroversion Score	Recorded Arm Movement (mm. deflection)	N	Introversion-Extroversion Score	Recorded Arm Movement (mm. deflection)
II . .	17	M. F.	3 4	263 80 443	18.90 10.38	2 3	600 40 553	4.47 23.53	2 3	557 40 745	37.50 12.97
		M. and F.	7		14.00	5		15.77	5		26.83
III and IV .	32	M. F.	4 5	384 10 603	2.48 5.95	7 4	509 14 582	4.50 10.59	5 7	586 100 645	2.06 5.88
		M. and F.	9		4.34	11		6.76	12		3.97

Questionnaire Items Relating to the Recorded Arm Movement

$N = 64$ (.) = Groups I–II (,) = Groups III–IV 1, 2, 3, 4, 5 = Quintiles
+ = Yes ? = Question or Blank – = No

Do you have the habit of leaving a lot of tasks unfinished? 3–4

min. 1 +,?.?,–.– – – –,– –,–.–,–,–,–,–,–,
2 +.+,+,?.?.–.–.–.–.–.+.–,–,+,+,–,–,
3 +.+,+,?,–.–,–,–,–.–,– –,–,–,–,–,
4 +.+.+,?,?,– –.–.–.–.–.–,–,–,–,–,
max. 5 + +.+.+,+,?.–.–.+.– –.–,–,–,–,–,–,

Have your friends ever turned against you? 6–4

Has any of your family committed suicide? 6–7

min. 1 –.–.–.–.–.– – –,– –,–,–,–,–,–,–,

max. 5 + +,–.– – – – –.–.– –,–,–,–,–,–,–,

Is there a conflict in your nature between sex and morality? 6–10

max. 5 ?.?,–.–,–.–.–.–.–,–.–,–,–,–,–,–,–

Have you ever been bothered by vomiting? 6–17

Are you bothered much by blushing? 6–27

min. 1 ?.?.?,?,–,– –,–.–.– –.–,–,–

Do you feel you must do a thing over several times before you leave it? 8–5

min. 1 +.+.+.+,+,?.?,?,−.−.−.−,−.−.−,−,−,−,
2 +.+.+.+.+.+.+,+,+,+,?.?,?,−.−.−,−,
3 +.+.+.+,+.+,−.−.−.−.−.−.−,−,−,+,
4 +.+.+.+,+,?.?,−.−.−.−.−.−,−,−,−,−,
max. 5 +.?.?.?.−.−.−.−.−.−,−,−,−,−,−,−,−,

Correlations of arm movement with other non-simultaneous measures of visceral status and reaction[1] suggest a relationship of motor responses to the functioning of the circulatory system and of the thermo-regulatory system, of which the galvanic changes are assumed to be a part. The relation of the motor reaction produced by the shocks to the degree of conditioning as measured by the galvanometer or blood-pressure apparatus is, perhaps, an indication of a motor factor in the conditioning of visceral reactions. The fact that cortical centers for the galvanic response have been demonstrated near the motor cortex of the cat (Langworthy and Richter, 1930), or in the motor cortex (Wang, Pan, and Lu, 1930), adds plausibility to this conception.

The amount of recorded arm movement, as evident in Tables 73 and 74, shows no relationship either to the neurotic inventory or to the introversion-extroversion scores. Nor does a study of the relation of arm movement to the answers to the composite scores or to the individual questions of the personality schedule show any very marked tendencies. The few suggestions of a "neurotic" tendency on the part of the individuals with the large reactions are offered by histogram for the reader's consideration.

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[1] See discussion under head of various physiological measures, especially minimum resistance, page 196.

COMPOSITE SCORES

In order to obtain a greater reliability than characterizes the histograms compiled from the answers to a single question, we have combined the data on various related questions into composite scores. The values of various correlations with these composite scores have already been presented, along with the data on various physiological measures. The groupings of personality items we have made are, as far as possible, empirical groupings, depending on relationships intrinsic to the material with which we have to deal. Empirical or intrinsically determined groupings of personality and physiological reaction tendencies have been arrived at by tabulating the instances where our original list of histograms showed regressions between various physiological measures and specific personality items. Where several of the physiological measures appeared related to two[1] or more of a group of questions, each of which was, in turn, related to two[1] or more of the related physiological measures, we have inferred that there was possibly a significant personality-physiological interrelationship to be studied.

For example, we found that physiological measures No. 7, No. 6, and No. 8 were related by the histograms to the questions, "Did you ever have anemia badly?" and "Do you find it necessary to watch your health carefully?" The question, "Do you prefer participation in competitive intellectual amusements to athletic games?" was also found to be related to measures No. 7 and No. 6 and was, therefore, included in the list of interrelated personality items. The physiological measure No. 14 was in turn found related to two of the above mentioned personality items; and it was, therefore, added to the list of related physiological measures—and thus the nucleus of this constellation was built up around related physiological measures. On examination of the personality items thus selected, it was found that there was a certain logical unity relating them: they all were somehow related to physical vitality and general health. We gave this constellation, therefore, the designation Health No. 1; and with these questions as a nucleus, we proceeded to canvass the entire personality inventory for other items of similar connotation.

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[1] A double interrelationship of the measures was the criterion arbitrarily selected here simply because our first effort to employ triple or quadruple interrelationships did not work, because of the limited number of histograms available.

On the other hand, there were other health items which were related to a group of physiological measures not markedly related to the first group of questions. For example, questions such as "Are you troubled by constipation?" and "Do you have queer unpleasant feelings in any part of your body?" were related to physiological measures No. 11 and No. 20. The question, "Does your heart sometimes sound in your ears so that you cannot sleep?" was related to measures No. 20 and No. 9, the latter measure, in turn, being related to the foregoing question on constipation. (Only physiological measure No. 15 showed appreciable relation both to this group of personality items and to those in Health No. 1.) The examination of this group of personality data revealed again a prevailing relationship to health,[1] and they were accordingly designated Health No. 2. These questions were, however, typically of a different character from those in Health No. 1, as has been noted elsewhere.

Other consistencies in the physiological-personality interrelationships were determined in essentially the same manner, and the personality items thus selected were then used as nuclei about which to assemble into constellations other personality items judged to be of similar import.

Although we have since excluded some of the histograms used in our original tabulation, because they showed too slight evidence of regression, and notwithstanding the fact that we now see several instances where our classification of questions could be improved, we feel that any changes which we might now make would result only in intensifying rather than in decreasing the observed relations between physiological syndromes and personality constellations.

The lists of questions constituting the personality constellations follow. The empirically determined questions which served as "nuclei" of the constellations and the arbitrary additions to the list are indicated separately for the reader's consideration.

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[1] There were a few non-health items which were equally well related to the "melancholic" constellation. On account of this general character they have been included with the latter measure.

A. "Health No. 1 (somasthenic?)[1]" personality constellation.

3-6 Are you frequently bothered by indigestion?
3-34 Do you find it necessary to watch your health carefully?
4-30 Did you ever have heart trouble?
5-26 Do you prefer participation in competitive intellectual amusements to athletic games?
8-6 Did you ever have anemia badly?

Additions to the foregoing personality constellation on the basis of judged similarity:

2-13 Have you ever had a nervous breakdown?[2]
3-20 Do you like indoor sports better than outdoor sports?
5-11 Do you feel tired most of the time?[2]
7-2 Do you usually feel well and strong? (−)[3]
7-23 Would you rather work indoors than outdoors?[2]
8-18 Have you a good appetite? (−)[3]
8-21 Are you bothered by fluttering of the heart?

B. "Socially inactive" personality constellation.

1-10 Do you take responsibility for introducing people at a party? (−)[3]
3-2 Do you keep in the background on social occasions?
3-5 Have you found books more interesting than people?
4-28 Do you allow people to crowd ahead in line?
5-4 Do you have difficulty in making friends?
6-20 Is your mother dissatisfied with her lot in life?
7-12 Are you shy with girls?
8-17 Do you often get interested in people you meet? (−)

Additions to the foregoing personality constellation on the basis of judged similarity:

2-3 Are you careful not to say things to hurt people's feelings? (−)
2-4 Are you sometimes the leader at a social affair? (−)
2-11 Are you interested in meeting a lot of different kinds of people? (−)
3-29 Are you troubled with shyness?
4-7 If you come late to a meeting, would you rather stand or leave than take a front seat?
4-26 Do you like to be by yourself a great deal?

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[1] "Somasthenic" used in contrast to "neurasthenic" and to avoid confusion with the anatomical connotation of the term "asthenic" as used by Kretschmer.

[2] We would now class these items under Health No. 2.

[3] A minus sign in parentheses (−) indicates that "no" rather than "yes" is considered the "neurotic" answer and that the question has been scored accordingly.

4-31 Does it bother you to have people watch you at work, even when you do it well?
5-20 Do you make friends easily? (—)
5-31 Do you often feel that you do not get your chance in social conversation?
6-11 Do you ever cross the street to avoid meeting somebody?
6-13 Do you like to be with other people a great deal? (—)
6-23 At a reception or tea do you seek to meet the important person present? (—)
7-1 Do you hesitate to volunteer in class recitation?
7-9 Do you enjoy social gatherings just to be with people? (—)
7-11 Are you shy with boys?
7-20 Do you ever take the lead to enliven a dull party? (—)
8-4 If you see an accident, are you quick to take an active part in giving help? (—)

C. "Health No. 2 (neurasthenic?)" personality constellation.[1]

1-5 Are you troubled much by constipation?
1-9 Does your heart sometimes sound in your ears so that you cannot sleep?
4-3 Do you often have bad pains in any part of your body?
4-15 Have you ever had spells of dizziness?
5-15 Do your eyes often pain you?
7-29 Do you sometimes have shooting pains in the head?
7-31 Do you often have queer unpleasant feelings in any part of your body?

Additions to the foregoing personality constellation on the basis of judged similarity:

3-9 Do you ever feel an awful pressure in or about the head?
4-19 Do you have many bad headaches?
5-14 Do you have the sensation of falling when going to sleep?
6-17 Have you been bothered by vomiting?
6-28 Is your head likely to ache on one side?
8-16 Do things ever swim or get misty before your eyes?
8-24 Do you faint easily?

D.[2] "Hyper-sensitivity"[3] personality constellation.

2-2 Do you worry too long over humiliating experiences?
2-14 Are your feelings easily hurt?

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[1] See note 2, page 221, relative to two desirable additions from Health No. 1.

[2] D, E, and F constellations (hyper-sensitivity, depression, and anxiety) tend to relate to the same physiological measures but have been separated for logical reasons. The measures given in the first list in each case belong to the "melancholic" syndrome. Those in the second list are those added on the basis of similarity.

[3] Hyper-sensitivity to personal affront.

4-27 Are you easily moved to tears?
6-18 Do you feel self-conscious when you recite in class?

Additions to the foregoing personality constellation on the basis of judged similarity:

5-3 Can you stand criticism without feeling hurt? (—)
7-18 Does criticism disturb you badly?
7-24 Do you lack self-confidence?
8-9 Are you troubled with feelings of inferiority?
8-28 Are you in general self-confident of your abilities? (—)

E.[1] "Depression" personality constellation.

3-11 Are you frequently burdened by a sense of remorse?
4-16 Do you get discouraged easily?
6-25 Do you often feel just miserable?
7-14 Do you feel that you are not satisfactorily adjusted to life?

Additions to the foregoing personality constellation on the basis of judged similarity:

1-6 Do you feel that life is a great burden?
2-7 Do you feel lonesome, even when you are with other people?
5-8 Are your daydreams usually about unpleasant things?
5-20 Have you ever been depressed because of low marks in school?
7-8 Are you frequently in low spirits?
7-17 Do you often experience periods of loneliness?
8-14 Do you have ups and downs in mood without apparent cause?

F.[1] "Anxiety" personality constellation.[2]

2-10 Are you afraid of falling when you are on a high place?
3-23 Does it make you uneasy to go into a tunnel or subway?
4-13 Have you ever been afraid that you might jump off when you were on a high place?
5-19 Do you have a great fear of fire?
6-13 Are you frequently troubled with nightmares?
7-27 Do you find it difficult to speak in public?

Additions to the foregoing personality constellation on the basis of judged similarity:

1-3 Do you get stage fright?
3-19 Do you worry over possible misfortunes?
3-25 Are you often afraid of contracting disease?
3-27 Are you frequently worried about religion?
3-30 Have you ever been afraid of going insane?

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[1] See note 1, page 222.

[2] The list of physiological measures relating to this constellation includes some of the same ones as Health No. 1. This is explained by the fact that these give evidence of a negative relationship with items positively relating to Health No. 1.

3-35 Are you often frightened in the middle of the night?
4-1 Does it make you uneasy to sit in a small room with the door shut?
4-21 Does it make you uneasy to cross a bridge over a river?
4-20 Do you dread the sight of a snake?
5-5 Are you troubled with the idea that people are watching you on the street?
5-9 Can you do the little chores of the day without worrying about them? (−)
5-11 Are you afraid when you have to take drugs?
6-2 Are you troubled by thoughts of death?
6-27 Are you bothered much by blushing?
7-21 Do you often feel self-conscious in the presence of superiors?
7-25 At night are you frequently troubled by the idea that somebody is following you?
8-7 Does it make you uneasy to cross a wide street or open space?
8-27 Are you frequently troubled with the fear of being crushed in a crowd?

G. "Excitability" personality constellation.

3-18 Do you get rattled easily?
6-0 Are you often in a state of excitement?
6-14 Can you stand the sight of blood? (−)
6-31 Do you get upset easily?

Additions to the foregoing personality constellation on the basis of judged similarity:

1-14 Do you lose your head easily in a dangerous situation?
2-12 Do a great many things frighten you?
3-10 Are you usually cool and composed in a dangerous situation? (−)
3-16 Do you lose your temper quickly?
8-2 Are you frightened by lightning?

H.[5] "Paranoid tendency" personality constellation.

1-11 Do you think most people are self seeking or malicious?
3-8 Are there many people that you dislike intensely?
3-12 Do people think you are selfish?
3-15 Do you usually trust people? (−)
3-33 Do people find fault with you more than you deserve?
4-4 Do you know of anybody who is trying to do you harm?
4-10 Is there anyone you want to get even with?
5-2 Have you ever felt as if someone were hypnotizing you and making you act against your will?
5-12 Have you been the scapegoat in the family life?

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[5] Constellations H, I, and J are merely groupings of possibly related items which were left over after selection of the preceding groups of questions.

5-21 Have your employers generally treated you right? (—)
5-24 Are you ever bothered by the feeling that people are reading your thoughts?
6-4 Have your friends ever turned against you?
7-4 Do you frequently feel that you deserve a better lot than you have?
8-13 Do you think that you are regarded as critical of other people?

[1] "Orientation toward reality."

2-5 Are your daydreams about improbable experiences?
3-7 Are you ever bothered by a feeling that things are not real?
4-1 Have you ever seen a vision?
4-10 Do you daydream frequently?
5-13 Does your mind often wander badly so that you lose track of what you are doing?
5-16 Do you frequently talk to yourself?
5-18 Are you absent-minded?
6-24 Do you ever have a queer feeling as if you were not your old self?

[1] "Sleep difficulties."

3-3 Do ideas often run through your head so that you cannot sleep?
3-20 Do you usually feel fatigued when you wake up in the morning?
3-22 Do you ever talk in your sleep?
7-6 Do you usually sleep well? (—)
7-19 Do you feel well rested in the morning? (—)
8-31 Do you ever walk in your sleep?

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[1] See note 1, page 224.

PHYSIOLOGICAL FACTOR ANALYSIS

With these personality constellations thus determined, the subjects were given scores on each, on the basis of the number of questions answered in a "neurotic" manner. Correlation coefficients, r, were then determined between the constellation scores and the standard scores on the physiological measures.[7] The larger correlations thus obtained are presented in the preceding sections dealing with the respective physiological measures, and they are again offered in tabular form according to the following procedure:

In Table 77 these correlation coefficients have been arranged by experimentation so that there is the least possible scatter of the larger coefficients both along the ordinate, on which physiological measures are listed, and along the abscissa, where the personality constellations are given. The groupings and their order are, in other words, empirically determined by internal relationships, and not by theoretical considerations. By this method of presentation it is possible to observe at a glance the amount of overlapping of the various personality-physiological relationships. It is also possible, where overlapping occurs, to find some logical unity relating neighboring groups of personality constellations and to apply a more or less general term of designation to the adjacent measures.

Having determined the correlations of the respective personality items with the various physiological measures, we may tentatively identify what we may call "syndromes" of reaction tendencies relating to any personality constellation. We have indicated in Table 77 the physiological measures showing the highest correlations with the respective personality constellations in bold-faced type. The physiological measures thus designated under any constellation constitute the syndrome. For example,

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[7] Standard scores, $\frac{\text{deviation from mean}}{\sigma}$, were determined separately for groups I–II and III–IV, and then combined.

No. of Measure Sheet*	Physiological Measurements		Sleep Difficulties	Health No. 1 (Somaesthetic Tendencies)	Socially Inactive Tendencies
−4	Galvanic reaction immediately after warning		.114	.176	.049
−12	Total resistance change, initial to minimum		.151	.134	.080
−8	Galvanic reaction to first three shocks		.120	.100	.114
−7	Spontaneous galvanic reactions, 2 minutes of anticipation		.132	.135	.099
−6	Resistance drop, 2 minutes of anticipation		.152	.310	.097
−16	Galvanic reaction to conditioned stimuli		.100	.082	.137
19	Extinction of conditioned reaction		.000	.146	.038
−14	Galvanic recovery in 3 seconds		.133	.265	.200
3	Blood-pressure reaction to non-conditioned stimuli		.060	.153	.162
−11	Spontaneous galvanic reactions between shocks		.133	.213	.179
−15	Recovery-reaction quotient	Neurotic syndrome	.037	.101	.182
20	Resistance rise in 2 minutes of rest		.185	.090	.098
−18	Association of conditioned with conditioning stimuli		.098	.050	.182
17	Conditioned blood-pressure reaction		.057	.046	.184
−9	Blood-pressure reaction after shocks		.147	−.036	−.055
−13	Minimum resistance reached		.041	−.065	−.045
10	Adaptation in the galvanic reaction		−.052	−.104	.005
−1	Initial resistance level		.078	.011	.014
2	Galvanic reaction to non-conditioned stimuli		−.059	.004	.017
5	Blood-pressure reaction after warning		−.000	−.017	−.046
	Intercorrelation of the personality constellations		↓ .519	↓ .534	↓ .44

Tentative designations of groups of constellations

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* *Signs.*—In order to avoid confusion of signs in the table, the larger coefficients of correlation of any m
by −1, in order that this positive correlation with "neurotic" tendencies might be obtained. The values

† The elimination of one subject changes these coefficients to the following values: (−.1

PERSONALITY CONSTELLATIONS*

sion	Anxiety	Hyper-sensitivity	Excitability	Paranoid Tendencies	Extroversion (Manic-Depressive Tendencies)	Neurotic Inventory	Disorientation toward Reality
52	−.128	−.099	−.052	.027	−.083	.103	−.098
02	−.111	−.183	−.077	.004	−.086	.145	.092
01	−.073	−.104	−.105	.030	−.130	.125	.086
53	.042	−.033	.045	.034	−.261	.112	.043
23	−.050	−.058	−.014	.027	−.183	.123	−.000
17	.008	−.041	.007	.056	−.115	.111	.002
15	−.007	.037	.001	−.048	.144†	.051	−.047
08	.001	−.039	.096	.060	.007	.213	.130
06	−.027	.055	.070	−.068	−.088	.132	.123
74	.100	.155	.096	.020	−.006	.108	.100
62	.188	.143	.130	.060	.037	.166	.168
69	.197	.298	.188	.008	−.016	.100	.000
66	.272	.212	.135	.072	−.126†	.107	.073
08	.190	.228	.090	.194	.079	.211	.182
97	.162	.108	.252	.178	−.101†	.120	.029
95	.017	.111	.117	.181	.018	.031	.055
41	−.016	−.013	.196	.043	.051	−.016	−.024
12	−.037	.007	−.025	.211	.079	.065	.043
52	.054	.076	.027	−.067	.140	−.035	.074
56	.046	.012	−.042	−.074	.296	.002	.076
↓ .680	↓ .810	↓ .721	↓ .507	↓ .118	↓ .124		

stellation

lancholic Constellation.
nti-ego (?) Reactions)

motional Instability

Hyper-reactivity (?)

[illegible] are presented as positive. It was necessary, therefore, to multiply all of some physiological measures ns indicate instances where this was done.

086; (−6) blood-pressure reaction after shocks = −.015 ± .093; (19) extinction = − [illegible]

physiological measures 7, 6, and 14 are tentatively designated as the "somasthenic tendency"[1] syndrome because they relate to Health No. 1, the personality constellation for "somasthenic tendencies." Correlating the combined standard scores for each syndrome with the corresponding personality constellation score gives the coefficients in italic bold-faced type on the diagonal of Table 78.[*] Correlation coefficients less than .10 are in all these tables given in light-faced type.

The tentative designation of a physiological syndrome by the name of the corresponding personality constellation with which it correlates is ultimately justifiable to the extent that there is a higher correlation with that constellation than with any other constellations. To the degree that this correlation is reliably greater than that with other constellations, we have evidence of a physiological differentiation of the personality traits represented by the constellations.

The coefficients of correlation of each syndrome with its own constellation, and with all other constellations, are presented in Table 78. The correlation coefficient of each syndrome with its *proper* constellation[2] is in each case given in italic bold-faced type, and is found in a diagonal running from the upper left- to the lower right-hand corner of the table. We are interested in the relation of these *proper* correlations of the syndromes, to their next highest correlation.[3] Of course, if there are correlations higher than those found on the diagonal, the syndrome is obviously misnamed. Such correlations are also printed in bold-faced type but not given in italics. Only in the case of "sleep difficulties," which did not fit well with the data of Table 77, and in the case of "depression" and "anxiety," the syndromes of which are identical and have a high degree of correspondence with "hypersensitivity,"[4] does any correlation appear larger than that between a syndrome and its proper constellation. If we recombine the "hyper-sensitivity," "depression," and "anxiety" constellations into the empirical, or intrinsically determined, "melancholic (?)" syndrome, from which they were abstracted, and obtain the correlation between the "melancholic" constellation and the "melancholic (?)"[1] syndrome, we have corrected this difficulty and we have a correlation between the syndrome and its *proper* constellation slightly larger than any other. It is, however, not much larger than the correlation with "neurasthenic" tendencies, the latter being within the "neurotic" constellation, of which the "melancholic" constellation is a part, and with which it is highly correlated. After this regrouping of hyper-sensitivity, depression, and anxiety, the correlations are in all cases, except for "sleep difficulties," larger than any other correlation; but the differences are not sufficiently greater than the P.E. of the difference[2] to be considered reliable. A possible inference is that we have measures on a series of overlapping sections of a continuum rather than on a number of discrete entities.

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[1] See note 1, page 221.

[2] These correlations of a syndrome with its proper constellation are designated in the formula as r_{cp}.

[3] The next highest correlation is designated in the formula (note 2, p. 228) as r_{cn}.

[4] It will be recalled that these items were separated for logical, not for "empirical," reasons (p. 222).

We are led to infer the essential continuity of our data even when we attempt to make measurements on sections of this continuum which show a minimum of overlapping. For example, we may confine our comparison, as in Table 79, only to the correlational data comprising the syndromes corresponding to (1) "somasthenic" tendencies, (2) "neurasthenic" tendencies, and (3) "paranoid" tendencies. The continuity of the relationships is still apparent in the data selected from Table 77 which are given in the upper section of Table 79, although the differences between r_{aa} and r_{ab}, as indicated in the data selected from Table 78 which are shown at the bottom of Table 79, are over three times the P.E. of the differences. They are large enough so that without the

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[1] This same group of physiological measures has also been used as the "neurotic" syndrome.

[2] The formula of Filon and Pearson (1898) in the form presented by Ackerson (1926, p. 65) has been employed in calculating the P.E.'s of the differences between the *r*'s as follows:

$$\frac{.67448975}{\sqrt{N}}\sqrt{\begin{matrix}(1-r_{ab}^2)^2+(1-r_{ac}^2)^2-2r_{bc}(1-r_{ab}^2)(1-r_{ac}^2)\\ +r_{ab}r_{ac}(1-r_{ab}^2-r_{ac}^2-r_{bc}^2+2r_{ab}r_{ac}r_{bc})\end{matrix}}\;.$$

PHYSIOLOGICAL SYNDROMES† (Groups of Physiological Measures Giving the Highest Correlations with the Respective Personality Constellations and Tentatively Designated Accordingly)		Sleep Difficulties	Health No. 1 (Somasthenic Tendencies)	Socially Inactive Tendencies	Health No. 2 (Neurasthenic
Sleep difficulties (Measures −6, −7, −11, 20)		***.270***	.220	.103	.2
Health No. 1 (somasthenic[?] tendencies) (Measures −6, −7, −14)		.107	***.248***	.150	.1
Socially inactive tendencies (Measures −11, −14, −15, 17, −18)		.131	.226	***.384***	.3
Health No. 2 (neurasthenic tendencies) (Measures −15, −18, 20)		.132	.140	.163	***.3***
Depression (Measures −15, 17, −18, 20)	Melancholic Syndrome	.187	.164	.304	.32
Anxiety (Measures −15, 17, −18, 20)		.187	.164	.304	.3
Hyper-sensitivity (Measures 17, −18, 20)		.170	.070	.293	.2
Excitability (Measures 10, −9, 20)		.169	.006	.021	.1
Paranoid tendencies (Measures −7, −9, −13, 17)		.169	.015	.108	.0
Melancholic syndrome (Measures −15, 17, −18, 20)		.187	.164	.304	.3

relation of a syndrome with a constellation. Bold-fa

‡ $r_{s,p}$—the correlation coefficient of a syndrome with the st highest coefficient to
of correlation larger than r_{s}.

S AND PERSONALITY CONSTELLATIONS[a]

	RSONALITY CONSTELLATIONS								ADDITIONAL PERSONALITY DATA		
					Difference between r_{14} and r_{16}						
	Hypersensitivity	Excitability	Paranoid Tendencies	Introversion-Extroversion Test	Difference $r_{14}-r_{16}$	P.E. Difference $r_{14}-r_{16}$	Difference $r_{14}-r_{16}$ / P.E. Diff. $r_{14}-r_{16}$		Neurotic Tendency	Disinclination toward Reality	Intelligence Test Score
4	142	140	004	— 144	**	. .	. . . .		.236	097	137
0	— 028	054	.075	— 101	.151	.065	2.3		.187	.066	088
4	231	153	.124	— 017	.070	050	1.4		.195	187	— 058
3	144	182	.063	— 036	158	.057	[illegible]		100	083	— 058
8	346	238	.168	— 000	**	.			.200	102	.006
8	346	238	168	— 002	**	. . . .	.		.200	.102	.006
	270	228	152	— 035	.195	040	[illegible]		.272	.165	.121
5	.100	282	.145	023	.105	.060	1.8		.155	.038	— .112
1	.205	.191	.229	.073	032	053	0.6		.227	.138	.075
		238	.168	— .000	.038	052	0.7		.200	.102	.006

rolic
ution

d—coefficients of correlation higher than r_{16}.

evidence of the previously presented data we might infer that each class of reactions was a type, discrete and different in kind

TABLE 79

INTERRELATIONSHIPS BETWEEN THREE SELECTED NON-OVERLAPPING

a Selected from Table 77

							$\frac{r_{12}-r}{S.D.}$
−7	Somasthenic	.335	.005	.034			
−6	tendencies	.320	.030	.027			
−14	syndrome	.244	.118	.060			
−15	Neurasthenic	.190	.230	.069			
20	tendencies	.000	.271	.008			
−18	syndrome	.030	.266	.072			
−9		−.036	.185	.178			
17	Paranoid	.040	−.070	.204			
−13	tendencies	.003	−.020	.183			
−1	syndrome	.011	−.113	.211			

Corresponding Data from Table 71

−7, −6, −14	Somasthenic tendencies syndrome	.348	.116	.075	.132	.070	3.3
−15, −18, 20	Neurasthenic tendencies syndrome	.140	.389	.063	.240	.070	3.4
−1, −9, −13, 17	Paranoid tendencies syndrome	.015	.031	.329	.297	.070	4.2
Intercorrelations of personality constellation. . .			.438	.444			

from the others. Of course, it may be that this is the case and that the gradation of the series is a result of mixing reaction types in differing proportions. The data do not definitely answer the question whether we are dealing with discrete entities in mixed proportions or with an unbroken continuum.

Whether or not this hypothetical continuum of which we speak tentatively should be thought of as a straight line rather than some hyperbolic function is not determined by our data. It is true that there is a suggestion of linearity in the fact that certain measures at the top of Table 77 correlate positively at what we have tentatively termed the "hypo-reactive (?)" end of the table and negatively at what we have questioningly designated as the "hyper-reactive(?)" end. But even here the fact that the area of greatest negativity at the top of the table occurs somewhat to the left of the excitability, paranoid, and manic extreme is suggestive of a flexion of the line of relationship, and it may be that we have evidence of at least two "dimensions" in our variable. Indeed, it is obvious that the terms "hypo-reactive" and "hyper-reactive" do not adequately represent the two extremes of our data, although we have not, to date, been able to find better general designations.

SPECIAL GROUPS OF DATA

THE "NEUROTIC" CONSTELLATION AND "NEUROTIC" SYNDROME

The data of Table 77 show a rather marked tendency for a group of personality constellations including (1) "socially inactive tendencies," (2) "neurasthenic tendencies," (3) "hyper-sensitivity," (4) "depression," and (5) "anxiety" to correlate highest with the following group of physiological measures: (1) the recovery-reaction quotient, (2) the resistance rise during 2 minutes of rest after stimulation, (3) the percentage of association of the conditioned with the conditioning stimuli, and (4) the conditioned blood-pressure rise. We have called this group of personality constellations, all relating more or less to the same physiological measures, the "neurotic constellation" because it comprised the larger part of what we judged to be the truly "neurotic" tendencies. We have tentatively designated the four physiological measures the "neurotic syndrome" because of their relationship to this "neurotic" constellation. These are measures which, so far as we may judge from our previous consideration of them, have the following significance under our test conditions: (*a*) No. 15, small recovery-reaction quotient—concern or anxiety regarding the shocks, probably thereby accentuating reaction and reducing recovery; (*b*) No. 20, large recovery during rest—overreaction to the shocks, with great relief (?) and large recovery at the cessation of stimulation; (*c*) No. 18, small percentage of association—overreaction to the shocks with relief (?) at their cessation and consequent small reactions to the succeeding clicks; (*d*) No. 17, large conditioned blood-pressure reaction—"ideational (?)" reaction to the conditioned clicks.

The combination, by addition, of the subjects' standard scores[1] on each of these measures gives their scores for the "neurotic" syndrome. These combined scores on the "neurotic" syndrome correlate with various personality scores as follows, in order of the magnitude of the coefficients:

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[1] See note 1, page 226.

With scores on the melancholic constellation	.368 ± .060
With scores on the "neurotic" constellation	.364 ± .060
With scores on hyper-sensitivity constellation	.546 ± .062
With scores on the anxiety constellation	.338 ± .062
With scores on Health No. 2 (neurasthenic tendencies) constellation	.330 ± .062
With scores on socially inactive constellation	.304 ± .063
With scores on the depression constellation	.303 ± .064
With total scores on the neurotic inventory	.200 ± .067
With scores on the excitability constellation	.238 + .066
With disorientation toward reality	.102 ± .065
With scores on sleep-difficulties constellation	.187 ± .068
With scores on paranoid-tendencies constellation	.168 ± .068
With scores on Health No. 1 (somasthenic tendencies) constellation	.104 ± .068
With intelligence test scores	.066 ± .079
With scores on introversion-extroversion	– .002 ± .086

Another physiological measure relating somewhat to the neurotic constellation, but not so consistently as those already mentioned, is No. 9, the blood-pressure reaction to the shocks. A large drop in blood pressure after these sensory stimuli seems to some extent a "neurotic" symptom. The most marked correlations are (–) blood pressure with neurasthenic tendency, $r = .185 \pm .068$; with paranoid tendencies, $r = .178 \pm .068$; and with excitability, $r = .251 \pm .066$.

It is evident from Table 77 that there are five personality constellations which do not correlate consistently with the "neurotic" syndrome. These are (1) Health No. 1 ("somasthenic [?]" tendencies), (2) excitability, (3) "paranoid" tendencies, (4) sleep difficulties, and (5) "orientation toward reality." These constellations of personality data should be omitted from the list of supposedly "neurotic" items in order to obtain the highest consistency of correlation of questionnaire scores with our tentatively determined physiological indicators of "neurotic" trend.

HEALTH NO. 1—SOMASTHENIC (?) TENDENCIES

The study of the various questions relating to health made it quite clear that some health items correlated with one group of physiological measures while others related to another group. This empirical differentiation of the personality data required a separate treatment of the two sets of health items; we designated them for convenience "Health No. 1" and "Health No. 2." Inspection of the items within the first of these (pp. 219 ff.) revealed a predominance of reference to various sorts of physical weakness; and we gave to this constellation, therefore, the tentative designation "somasthenic tendencies" (in contrast to "neurasthenic tendencies"). Health No. 2, on the other hand, gave a suggestion that the difficulty was chiefly "nervous" or "functional," and we have tentatively called the items included under this head "neurasthenic tendencies." The additions to the respective lists which were made on the basis of judged similarity have, in a few instances, probably been included in the wrong list. The chief physiological correlates of Health No. 2 are within the "neurotic" syndrome.

Health No. 1 ("somasthenic tendencies") shows its chief correlations with a group of measures of the magnitude of the galvanic reactions. Large per cent galvanic reaction under a number of different circumstances correlates negatively with scores on the "somasthenic" group of health items, as follows in the order of magnitude.

	Correlations with "Somasthenic" Group of Health Items
6. Resistance drop during 2 minutes of anticipation	−.310 ± .064
14. Galvanic recovery during 3 seconds	−.265 ± .068
7. Spontaneous galvanic reactions during anticipation	−.235 ± .067
11. Spontaneous galvanic reaction between shocks	−.213 ± .067
4. Immediate galvanic reaction to the warning	−.176 ± .069
8. Galvanic reaction to shocks	−.160 ± .068
9. Extinction of the conditioned reaction	+.246 ± .070
12. Total galvanic change—initial to minimum resistance	−.154 ± .069

One blood-pressure measure is also included:

3. Blood-pressure reaction to the non-conditioned stimuli. +.153 ± .070

One measure of the "neurotic" syndrome also shows appreciable correlation:

15. Recovery-reaction quotient . . . . — .191 ± .071

These are measures which involve reaction or immediate recovery from excitation. Large values suggest a high lability of the temperature-regulating (especially sweat-secreting) mechanisms of the body. Lack of such activity appears to be some presumption of poor health. Related evidence from the work of other investigators has already been cited under the discussion of the galvanic reaction to the shocks, page 126. W. S. Brown's evidence that the galvanic reflex is an index of soundness of constitution, bodily activity, desire to excel, etc.; Cattell's conviction that it relates to force of character; the evidence of Washburne *et al.* that large reactions characterize a cheerful disposition; and the extensive evidence of *deficient* reactions in various psychoses (pp. 91-92), may be recalled at this time.

On the whole, these measures of galvanic reactivity which have all manifested some negative relation to general health and, as will be noted in the next section, some positive relation to extroversion (or manic-depressive *tendencies?*), have not shown relationship to emotionality. The largest correlation coefficients obtained are the following: galvanic reaction immediately after the warning, with anxiety, .128 ± .070; total galvanic change (initial to minimum resistance), with anxiety, .111 ± .070, and with hyper-sensitivity, .183 ± .068; galvanic reaction to shocks, with hyper-sensitivity, .164 ± .068, and with excitability, .103 ± .069. A significant thing here is that measures of galvanic reaction showing a slight positive correlation with these emotional constellations show a negative relationship to "somasthenic tendencies." We might infer a degree of incompatibility between physical subnormality and these forms of emotionality.

INTROVERSION-EXTROVERSION

The correlations in Tables 77 and 78 suggest a tendency, except in the case of two measures (Nos. 4 and 12) which are correlated with anxiety, for large galvanic reactions and the absence of "somasthenic" tendencies to be a concomitant of extroversion (or of manic-depressive tendencies).[1] Furthermore, practically none of the measures which are in any degree functions of "neurotic" tendencies (two minor exceptions, Nos. 18 and 9)[2] give better than near-zero correlations with introversion-extroversion. The correlations with extroversion are as follows, in order of magnitude:

5	Blood pressure after warning	.296 ± .093
7	Spontaneous galvanic reactions during 2 minutes of anticipation	.261 ± .026
	Strength of shock (appendix)	.210 ± .086
6	Resistance drop during 2 minutes of anticipation	.183 ± .088
19	Extinction of conditioned galvanic reaction	— .144 ± .086*
2	Galvanic reaction to the non-conditioned stimulus	.140 ± .090
8	Galvanic reaction to first three shocks	.130 ± .088
18	Association (per cent) of conditioned with conditioning stimulus	.126 ± .084*
16	Galvanic reaction to the conditioned stimulus	.115 ± .085
9	Blood-pressure reaction after shocks	.101 ± .091*

* See note (f), Table 77.

In a general way extroversion appears to correlate with large physiological reactivity in measures where this reactivity is not measurably affected by "neurotic" trend.

CONDITIONING AND INTELLIGENCE

The correlations of various physiological measures with intelligence test scores may prove of considerable significance. A summary of various findings is given in Table 80. That these correlations of intelligence with physiological change are not functions of some common "neurotic" factor is borne out by the fact that, although all of them correlate positively with intelligence, some of them (conditioned blood pressure, and resistance rise during rest) correlate positively while other measures correlate negatively with "neurotic" symptoms.

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[1] The "extroverts" on whom this test was standardized were "manic depressives" (Gilliland and Morgan, 1931).

[2] The elimination of one subject from the population overcame these discrepancies, as noted in Table 77.

It is a fact, however, that the combination of two measures which correlate negatively, and one which correlates positively, with "neurotic" symptoms gives one instance of correlation with a personality constellation, e.g., −.186 ± .068 with "neurasthenic" tendencies. Whether we have, in this case, an indication of a "cognitive general factor" in psychoses such as that suggested by T. V. Moore (1930) may only be determined by further study on psychopathic material.

Correlation of Intelligence Test Scores with:	Groups I–II	Groups III–IV
Syndrome of conditioning:		
No. 18 Percentage of association of conditioned with conditioning stimuli	.235 ± .115	.300 ± .090
No. 17 Conditioned blood-pressure rise	.414 ± .100	.177 ± .102
No. 16 Conditioned galvanic reaction	.302 ± .112	.207 ± .098
The syndrome of conditioning (measures 16, 17, and 18), groups I–II and III–IV	.389 ± .067	
Other measures:		
No. 20 Rise in resistance during 2 minutes of rest	.137 ± .100	.136 ± .103
No. 9 Blood-pressure rise after shocks	.097 ± .115	.203 ± .090

The *syndrome of conditioning* (measures 16, 17, and 18) correlates as follows with various constellations and test scores:

Intelligence test scores	.389 ± .067
Neurasthenic tendencies	−.186 ± .068
Extroversion	.153 ± .084

All other constellations give correlations less than .059.

The correlations between conditioned reactions and motor response to the conditioned stimuli in both groups I–II and III–IV (see Table 74) suggest the close relation between motor and visceral mechanisms, even suggesting the possibility of a motor factor in the conditioning of visceral reactions. The evidence of a cortical center for the galvanic reaction located near the motor area of the brain (Langworthy and Richter, 1930) or in the motor area (Wang, Pan, and Lu, 1930) gives further substance to such a conception.

It is to be noted that the conditioning here under consideration is that involving the association of an auditory click with an electric shock. It is possible that conditioning to a wider range of stimulating conditions, along with proper weighting of the various measures thus obtained, may give still higher correlations with intelligence.

GALVANIC AND BLOOD-PRESSURE CHANGES AFTER SENSORY AND IDEATIONAL STIMULI

As this experiment included (1) a verbal warning, (2) auditory clicks and electric shocks, and (3) auditory clicks conditioned by presentation with the electric shocks, it seemed likely that we had here stimuli which might be classified as "ideational" and "sensory," in the sense in which these terms were used in a previous investigation (Darrow [3], 1929). And since we were here obtaining simultaneous blood-pressure and galvanic reactions to these stimuli, we were interested to determine possible differences in the relative magnitude of these changes under the varying stimulating conditions. In our earlier studies of this problem, evidence was presented supporting the following conclusions:

(1) That the immediate reflex response to momentary sensory excitation differs from the response mediated by associative processes, or ideas, aroused by the stimulus, and that both of these reactions have been termed "emotion."

(2) That momentary sensory stimuli are relatively more effective than ideas in exciting peripheral changes such as vasoconstriction, perspiration, and the galvanic skin-reflex, while associative processes or ideas are more effective in increasing cardiac activity as indicated by pulse rate or blood pressure.

In the present study we were especially interested in determining the following:

1. Whether verbal (ideational?) warning would produce a different relative magnitude for the accompanying blood-pressure

TABLE 81

BLOOD-PRESSURE AND GALVANIC REACTIONS TO VARIOUS STIMULI

This table shows that, with the exception of reactions to the verbal warning (an ideational stimulus?), both the galvanic and blood-pressure reactions fall into the following series in order of increasing magnitude: (1) non-conditioned stimuli, (2) conditioned stimuli, (3) reaction to the second three shocks, and (4) reaction to the first three shocks. The table further shows that the galvanic reactions to the warning were smaller than those for the second three shocks (and in two out of three groups smaller than for the conditioned reactions), while the blood-pressure reactions averaged in all groups considerably larger than for the first three shocks.

Reaction (Average)	Group I N = 30		Group II N = 22		Groups III–IV N = 36	
	Galvanic	Blood Pressure	Galvanic	Blood Pressure	Galvanic	Blood Pressure
To warning . .	9.23	2.25	10.30	1.70	15.85	1.91
	S.D. 7.12	S.D. 3.10	S.D. 10.79	S.D. 3.85	S.D. 11.75	S.D. 2.53
To non-conditioned stimuli .	3.28	0.44	3.18	−0.14	3.54	−0.73
	S.D. 3.04	S.D. 0.93	S.D. 5.50	S.D. 1.01	S.D. 3.73	S.D. 1.17
To conditioned stimuli.	10.98	0.46	11.31	0.29	9.48	−0.12
	S.D. 7.84	S.D. 1.77	S.D. 8.88	S.D. 1.16	S.D. 6.21	S.D. 1.71
To second three shocks.	18.46	1.22	18.70	0.34	14.55	0.07
	S.D. 10.05	S.D. 1.95	S.D. 10.34	S.D. 1.53	S.D. 6.91	S.D. 2.33
To first three shocks.	21.32	1.38	19.00	0.97	15.35	0.36
	S.D. 11.50	S.D. 2.58	S.D. 10.36	S.D. 1.70	S.D. 7.17	S.D. 2.35

and galvanic changes than the non-conditioned clicks and the shocks.

2. Whether the use of sensory stimuli (the shocks) to condition the subject to other sensory stimuli (the clicks) would change the relative magnitude of the blood-pressure and galvanic reactions to the conditioned clicks so that the pattern of reaction would correspond, more closely than before, to that for ideational stimuli.

3. Whether the relative magnitudes of these reactions under different stimulating conditions have any significance for the study of personality.

The data presented in Table 81 rather convincingly answer the first two questions:

1. Employing the relative magnitudes of the blood-pressure and galvanic reactions after the clicks and after the first three and the second three shocks as a basis for comparison, we find the relative size of the blood-pressure response disproportionately great after the verbal (ideational?) stimuli.

2. From an examination of these same data we find no clear indication of an alteration in the relative size of blood-pressure and galvanic reactions attributable to the conditioning of a subject to one sensory stimulus by presentation of that stimulus with another sensory stimulus.

3. As to the significance of the relative magnitude of these measures for personality, the best clues we have are those already presented in Tables 11 (p. 95) and 61 (p. 182), where the combination of large galvanic with small blood-pressure changes after the non-conditioned and the conditioned stimuli was found most frequently in individuals whose answers to the questionnaire suggest a comfortable adjustment to life-situations. The relative magnitudes of blood pressure and galvanic reactions after other stimuli did not give a differentiation of answers to the various questions.

DISCUSSION AND CONCLUSIONS

From the study of twenty-one measures of physiological reaction in relation (1) to the neurotic inventory, (2) to the Northwestern University Introversion-Extroversion Test, (3) to the histograms showing the distributions of answers to the respective questions of the neurotic inventory, and (4) to composite scores obtained by compiling answers to groups of similar items from the neurotic inventory, we must conclude that in no instance have we demonstrated that temperamental type, as defined by the questionnaires used, is a result of the physiological traits measured. This is true even of the highest correlations that have been obtained between certain physiological measures and certain composite personality scores. There are five coefficients less than .310 and greater than .255 with probabilities less than 1 in 100 (Fisher, 1930) that they are attributable solely to chance. There are nine additional coefficients above .202 with probabilities less than 1 in 20 that they are due to chance.

Obviously, correlations of the magnitude of even the largest of these are not sufficiently high to justify using one of these measures as an index of the other. As an attempt to find a diagnostic or a predictive test, it must be conceded that our efforts have failed. Even when groups of physiological measures relating to the same personality variables are combined into "syndromes," and correlations run between the "syndrome" scores and scores on "constellations" of personality items, the coefficients still range between .303 and .381, much too low for the requirements of the tester. In an age of refined statistical criticism when a correlation of .400 is considered next to worthless, one can only feel hesitation in presenting data such as these. To offer the fact that this particular effort failed to show high relationships, as a proof of the non-existence of appreciable psychophysiological consistencies within the personality would, of course, have no point. Negative conclusions prove little, and may only cause one to question the technique or judgment of the experimenter. On the other hand, to present these data, and in addition to suggest that these low-order correlations taken together throw significant light upon the complex of behavior called "personality," is to invite criticism, if not to court annihilation at the hands of those whose statistics are adapted for the construction of psychological tests.

Nevertheless, we have presented the relationships which have been found for what they are worth. We have, in the case of each physiological measure, discussed its probable psychological or physiological meaning in the light of the low-order relationships revealed. In the discussion of possible meaning we have in all cases tried to keep it clear that we were under no illusion that we had in any instance a predictive or a diagnostic tool—that the interpretation could only be applied in a general way to group differences. And finally, in the combination of our low-order correlations into what appear to be their natural groupings in an attempt to arrive, by a sort of physiological "factor analysis," at psychophysiological dimensions, if there be such, we must emphasize the fact that any generalizations made apply only within our data. The work must be repeated with other groups of "normal" individuals, and with groups of psychopathic cases, of well-established diagnosis, before sweeping generalizations can be justified.

CONCLUSIONS

1. There is evidence that physiological reactions under certain specified conditions and certain personality traits, as revealed by the questionnaires, show a degree of concomitant variation. Those that correlate may be causally related, or may both be influenced by some as yet unknown common factors.

2. There is evidence that certain physiological measures related to a common personality variable tend to have a number of personality variables in common, and relatively few which are not in common.

3. There is evidence that this community of physiological reaction may be an empirical means of identifying, classifying, and abstracting the trends or dimensions of personality.

4. There is evidence that mutually related groups of physiological measures and personality variables may be simultaneously

arranged in two continuous overlapping series, both characterized by something akin to hypo-reactivity at one extreme and hyper-reactivity at the other extreme.

5. Personality constellations and related reaction syndromes may be selected at such distances along the hypothetical continuum that they do not appreciably overlap and that they are reliably differentiated from one another. The data do not determine whether or not these differentiated reaction tendencies represent discrete types of behavior rather than widely separated segments of a continuum.

6. There is evidence as to the probable significance—although we have demonstrated no relationships high enough for predictive purposes—of the various physiological measures for personality. The more important of these may be briefly mentioned:

a) The magnitude (per cent) of the galvanic reaction under different stimulating conditions appears (1) most closely related (positively) to physical health, (2) somewhat related (positively) to extroversion, and (3) only slightly related to anxiety or excitability (or emotionality?).

b) The galvanic recovery (per cent) during 3 seconds after the peak of reaction appears related positively to the general galvanic and motor reactivity of the subject, and negatively related to his resistance level. It is positively related to general health and inclination toward social participation.

c) The recovery-reaction quotient, a measure which is reduced in size by factors enhancing reaction and retarding recovery, appears to be one of the better indicators of the absence of "neurotic" tendencies.

d) The recovery of resistance during 2 minutes of rest after the cessation of stimulation is one of the higher correlates of "neurotic" trend, probably because it is a function of the amount of preceding psychological or physiological disturbance (?).

e) The association of the conditioned stimulus with the conditioning stimulus preceding, as measured by the percentage which the conditioned is of the conditioning reaction, is one of the better indicators of the absence of "neurotic" trend. It is positively correlated with scores on intelligence.

f) Adaptation of the galvanic reactions to repeated stimuli (indicating excessive initial reaction?) appears related to excitability.

g) Low resistance level is somewhat related to depression and to paranoid tendencies.

h) A drop in blood pressure after sensory stimuli (mild electric shocks) is chiefly related to excitability and to a less extent to "neurotic" trend.

i) A large rise in blood pressure after conditioned stimuli is positively related to "neurotic" trend.

j) The blood-pressure reaction as compared with the concomitant galvanic response is disproportionately great after the verbal (ideational?) warning.

k) The degree of conditioning of the visceral mechanisms controlling blood-pressure rise and galvanic changes is related to intelligence as measured by the American Council Intelligence Test.

l) The degree of blood-pressure and galvanic conditioning is related to motor reactivity as measured by the arm movement produced by the shocks.

m) Motor reactivity to the shocks is negatively related to (1) resistance level, and positively related (2) to total resistance change, (3) to spontaneous galvanic reactions between shocks, (4) to galvanic recovery during 3 seconds after the peak of reaction, and, as above noted, (5) to degree of conditioning as indicated by blood-pressure rise and galvanic change.

7. There is evidence that the various measures we have used may become more valuable (1) as we improve on our classification of the various personality variables, (2) as we study individuals on whom we have other data than those available by the questionnaire method, (3) as information is accumulated governing extreme or limiting conditions, and (4) as data accumulate on psychopathological cases.

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[1] A description of the equipment at the Institute is given by Darrow (1929 [2] and 1930).

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APPENDIX

GROUP DIFFERENCES AND SEASONAL (?) VARIATIONS IN THE DATA

As previously noted, the data which we have presented were treated in groups obtained respectively during four different quarters or terms at the university. Certain modifications of procedure characterized the work of the different quarters, recommended by experience in our work during the preceding quarters. These changes have already been discussed on pages 65–67, and tabulated in Table 1. Accompanying the changes, but not in all cases caused by them, are certain differences in the average results obtained for the various groups. These differences in results have in the preceding presentation been compensated by the use of standard scores whenever data from different and discrepant groups were combined. Averages on each of the physiological measures for each of the main groups of subjects are presented in Table 82. Here these measures are classified according as they are (*a*) those in which the differences are probably due to changes in the experimental procedure, (*b*) those in which they are probably due to individual or seasonal differences, and (*c*) those in which there are no appreciable differences.

The higher initial resistance in group I as compared with group II may possibly be attributed to the elimination of the preliminary dynamometer test in the latter group. This difference is slight, however, in comparison with the difference between these two groups and groups III–IV, a difference not attributable to any experimental conditions of which we are aware. We have already suggested the possibility of a seasonal variation for which hypothesis Cattell (1928) has offered some supporting evidence. Other measures preceding the shocks, and therefore not attributable to the change in shock intensity, are also presented in Table 2. In a general way they suggest a greater reactivity for groups III–IV than for I–II.[1] The smaller reactions effected by the electric shocks in groups III–IV, on the other hand, are clearly a function of the reduced intensity of the stimuli. The measurements which show no appreciable differences between the respective groups may be classified as (*a*) those which precede the administration of the shocks and are, therefore, unaffected by the change from double to single intensity,[2] (*b*) those which

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[1] It must be borne in mind that, whatever measure of galvanic reactivity is employed, it is inseparably a function of resistance level, and that the use of per cent resistance change is merely an attempt partially to compensate for that fact. See discussion of absolute and per cent resistance changes, page 256.

[2] Since standardization in all groups never involved more than single intensity, all groups were identical in this respect up to the time of administering the shocks in the experiment. After this point, groups I–II and III–IV might differ due to the difference in intensity of shock experienced.

TABLE 82

DIFFERENCES IN GROUP AVERAGES ON TWENT

	Group I N = 30		Group II N = 21		Groups III–IV N = 36	
	Av.	S.D.	Av.	S.D.	Av.	S.D.
(a) Measurements on which the groups differ owing probably to changes in experimental procedure:						
8. Per cent galvanic reaction to electric shocks:						
First three	21.32	11.56	19.60	10.30	15.35	7.17
Second three .	18.46	10.05	15.70	10.34	14.55	6.91
9. Blood-pressure rise after shocks:						
First three	1.38	2.58	0.97	1.70	0.36	2.35
Second three .	1.22	1.95	0.34	1.33	0.07	2.33
10. Decrease (adaptation?) in galvanic reaction to successive electric shocks.	2.89	5.36	0.96	6.84	0.70	4.20
12. Per cent resistance change, initial to minimum resistance.	52.68	20.38	50.23	17.84	46.73	15.56
15. Recovery-reaction quotient (average for first three shocks)	0.200	0.118	0.242	0.152	0.204	0.121
17. Blood-pressure change after the conditioned stimuli	0.46	1.77	0.39	1.16	− 0.14	1.71
20. Increase in resistance during 2 minutes of rest after stimulation.	16.21	12.85	21.26	17.37	7.58	14.51
(b) Measurements on which groups differ owing probably to individual (or seasonal?) differences (with one exception, conditions preceding the shocks):						
1. Initial resistance (÷1,000 ohms) . .	33.24	28.18	36.30	24.55	15.89	9.52
3. Blood-pressure reaction to the non-conditioned stimulus.	0.44	0.93	− 0.14	1.02	− 0.73	1.17

TABLE 82—*Continued*

	Group I *N* = 50		Group II *N* = 17		Groups III–IV *N* = 20	
	Av.	S.D.	Av.	S.D.	Av.	S.D.
4. Per cent immediate galvanic reaction to the warning	9.23	7.12	19.20	10.79	13.85	11.75
5. Immediate blood-pressure change after the warning	2.25	3.10	1.70	3.85	1.01	2.33
6. Per cent resistance change in 2 minutes following the warning	10.51	11.09	14.50	14.43	20.19	16.91
7. Spontaneous galvanic reactions during 2 minutes of anticipation of the shocks . . .	21.78	17.86	22.93	22.98	32.54	10.46
13. Minimum resistance reached during first series of shocks (+1,000 ohms) . .	25.00	21.45	13.03	11.70	8.12	5.48
19. Extinction of the conditioned reaction . . .	22.82	60.52	36.63	42.02	17.00	75.66
2. Measurements on which the groups do not appreciably differ:						
3. Per cent galvanic reaction to the non-conditioned stimulus	3.78	3.64	3.18	5.59	3.54	3.73
11. Spontaneous galvanic reactions (per cent) during intervals between the shocks . .	5.08	5.36	5.30	4.87	4.11	3.08
14. Galvanic recovery during 3 seconds after the peak of reaction to the shocks:						
First three	4.78	4.34	6.36	4.47	5.55	3.87
Second three .	7.78	5.64	8.01	5.50	6.73	3.81
16. Per cent galvanic reaction to the conditioned stimulus	20.08	7.84	11.31	8.88	9.48	6.21
18. Percentage of association of reaction to the conditioned stimuli (clicks) with the conditioning stimuli (shocks)	56.57	26.36	57.00	29.82	60.86	23.83

involve a relationship between different parts of a subject's reactions and which, therefore, may remain the same regardless of changes in the absolute magnitudes of reaction involved, and (*c*) those measures (recovery and conditioning) dependent to a considerable extent upon conditions within the subjects (7).

THE MOTOR STANDARDIZATION OF THE ELECTRIC SHOCK

The electric shock, as has been previously pointed out, was standardized in terms of the muscular reaction of the subject. Our first attempt to obtain a satisfactory standard electrical stimulus was directed toward keeping the impressed voltage constant, after the very common procedure of setting the secondary of an inductorium at uniform distances from the primary. Even when carefully measured voltages were applied, however, different subjects suffered markedly different effects; and for our purposes it seemed important that the stimulating value of the shocks should be as nearly as possible equal for all subjects. As an alternative, we tried to keep the amount of current passing through the subject constant, in the belief that if the current through a given part of the body were the same, the physiological and psychological effects might be equivalent. A transformer was used to step up the voltage from the 60-cycle 110-volt circuit, and the current was then cut down by a series of regulating high resistances in series with (1) the secondary, (2) a thermomilliameter, and (3) the electrodes attached to the subject. It was immediately apparent by this procedure that the regulation and equalization of the amount of current (milliamperes) through different subjects gave no better physiological or psychological equalization of the stimuli than had the use of a uniform impressed voltage.

The only means of obtaining electrical stimuli with approximately equal exciting value for different subjects appeared to be a standardization of the stimulus in terms of the reactions of the subjects. This was done by using a large indifferent electrode applied to some convenient body surface, and a small electrode to one of the more conveniently available "motor points," and then standardizing the motor reaction. We experimented with various "motor points" which can be easily reached. We finally determined upon a motor point which, when stimulated, does not give pain, and the response of which can be readily observed, measured, and controlled, as indicated below.

The large indifferent electrode consisting of a heavy bandage soaked in physiological salt solution is wrapped around the upper arm, with the subject's hand resting, palm up, on the table, and the small active electrode consisting of a half-inch zinc disk covered with kaolin zinc sulphate and cotton soaked in physiological salt, applied to the flexor muscle of the thumb, *m. flexor pollicis brevis*, in the neighborhood of the insertion of the nerve. The current is gradually increased, and the thumb is drawn slowly upward until a critical point is reached at which there is a marked change in the leverage of the muscle relative to the joint, and the thumb swings quickly inward toward apposition with the palm. After this latter point is reached, the subject may no longer voluntarily straighten the thumb. After he has been accustomed to this change by two or three trials, subsequent repetitions reach the critical point at the same magnitude of current, the variability being ordinarily less than 10 per cent. The stimuli required by different subjects showed a range of from 1 to 6 milliamperes at voltages of from 10 to 40 volts. The 60-cycle A.C. resistance of these subjects varied from 4,000 to 11,000 ohms.

The duration of the stimulus, as previously explained, was controlled by a pendulum which made a contact having a duration of 0.1 second at the middle of its swing. The contact consisted of a knife edge of copper cutting through a pool of mercury. A special mercury switch, operated by the pendulum, broke the contact before the return stroke, thus providing only one electrical contact for each double vibration of the pendulum. In the latter portion of this study the strength and uniformity of this stimulus was recorded on the same record with the physiological reactions by means of a vacuum thermocouple and a small supplementary Salomonson string galvanometer. These records demonstrated a remarkable uniformity in the stimuli for any given subject.

THE PHYSIOLOGICAL AND PSYCHOLOGICAL EQUIVALENCE OF THE STANDARDIZED SHOCKS

Standardization of the shock in terms of the motor reaction of the subjects, as has been previously noted, was for the purpose of obtaining a stimulus approaching the ideal of physiological equivalence for different persons. As previously observed, it requires no very extensive work with electric shocks to convince one that neither of the procedures ordinarily employed—that of keeping the current through the subject constant, or that of keeping the impressed voltage constant—produces physiological or psychological equivalence of stimuli in different subjects. In fact, the use of electrical stimulation for diagnostic purposes, as usually employed in the clinic, is dependent upon wide disparity in the thresholds of different individuals. We therefore sought to equate the muscular reactions of our subjects to a controllable and measurable tetanizing stimulus in the belief that this would offer an approach to physiological equivalence of stimulation, thus enabling us to study differences in reaction attributable to psychological conditions during the test. Our assumption that the stimulating value of a tetanizing electrical stimulus applied by good moist contacts of non-irritating 9 per cent sodium chloride to the skin over the motor point of a muscle may be gauged in persons (whose nervous systems are intact) by the magnitude of the skeletal reaction to that stimulus is based upon the fact that the subjective impression of such a stimulus seems to be largely proprioceptive, and, within moderate ranges, proportional to the contraction elicited. With good moist contacts the tetanizing effect may be felt within the muscle before any sensation is localized in the skin, and, with increased intensity of current, muscular pain may be induced before the induction of cutaneous irritation (our stimuli were not reported as painful). Only in the case of poor contacts at the electrodes does a cutaneous irritation appear. In so far, therefore, as proprioceptive excitation is a function of observable motor reaction, we feel that we have approached physiological uniformity for our stimuli.

We recognize, however, that this is an assumption; and in the case of all our measures of reaction we have inspected the average strengths of shocks

TABLE 83

INTENSITY OF THE STANDARDIZED SHOCK IN RELATION TO NEUROTIC INVENTORY SCORES

This table shows no consistent [illegible]e between the strength of shock required by A's and E's.

Group	Total N	Sex	Low Score (Non-neurotic)			Middle Score			High Score (Neurotic)		
			N	Neurotic Inventory Score	Standard Intensity of Shock	N	Neurotic Inventory Score	Standard Intensity of Shock	N	Neurotic Inventory Score	Standard Intensity of Shock
I	30	M	10	[illegible]	2.56				7	[illegible]	[illegible]
		F	5	[illegible]	[illegible]				8	[illegible]	[illegible]
				14						106	
		M. and F.	15		[illegible]				15		[illegible]
II	[illegible]	M.	6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		F.	[illegible]	[illegible]	[illegible]	5	[illegible]	[illegible]	5	[illegible]	[illegible]
				[illegible]			[illegible]			[illegible]	
		M. and F.	7		[illegible]	7		[illegible]	7		[illegible]
III and IV	30	M.	[illegible]	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		F.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5	[illegible]	1.55
				[illegible]			51			[illegible]	
		M. and F.	11		[illegible]	11		[illegible]	11		[illegible]

for the respective quintiles, to ascertain if the amount of current employed showed a tendency toward a relationship with that measure; and when any evidence of a regression appeared, we have determined the correlation, *r*, in order that we might assure ourselves as to what extent differences in the measure might possibly be a function of the strength of shock.

In the first place, no relation appears in Table 83 between the strength of shock and the total scores on the neurotic inventory. In Table 84 is evidence that the standard shock tended to be slightly greater for extroverts than for introverts. The correlation, *r*, between strength of shock (current) and introversion-extroversion scores is .210 ± .086 in groups II and III-IV.

That there is a correlation between the amount of recorded arm movement

TABLE 84

F THE STANDARDIZED SHOCK IN RELATION T

This table shows a tendency for the milliamperage of the shocks to be higher in the case of extroverts.

Group	Temp. F	Sex	Low Score (Introvert)			Medium Score			High Score (Extrovert)		
			N	Introversion-Extroversion Score	Standard Intensity of Shock	N	Introversion-Extroversion Score	Standard Intensity of Shock	N	Introversion-Extroversion Score	Standard Intensity of Shock
II	61	M.	8	.360	8.33	8	.506	6.11	4	.551	8.96
		F.	4	.611	1.78	4	.16	4.15	1	.30	1.85
				.465			.553			.742	
		M. and F.	12		2.95	12		3.63	5		2.69
III and IV	15	M.	2	.164	2.41	3	.509	1.48	5	.256	3.98
		F.	5	.511	2.40	4	.14	1.10	3	.14	3.80
				.507			.557			.605	
		M. and F.	12		2.52	14		1.33	12		2.95

	Groups I–II (Double Standard Intensity Shock)	Groups III–IV (Standard Intensity Shock)
Measures of simple reaction accompanying shocks:		
Per cent galvanic change	−.011 ± .093	.065 ± .102
Per cent resistance change initial to minimum resistance	−.071 ± .095	.095 ± .106
Blood-pressure reaction to shocks	.235 ± .091	.121 ± .101
Recorded arm movement	.270 ± .093	.205 ± .104* (−.107 ± .108)
Other measures with which relations appeared from examination of the average reactions for the respective quintiles:		
Initial resistance	−.351 ± .082	.112 ± .105
Blood-pressure reaction to non-conditioned stimuli	−.130 ± .094	−.198 ± .101
Spontaneous galvanic reactions between shocks	.214 ± .092	.118 ± .101
Minimum resistance reached	−.278 ± .088	.010 ± .105
Galvanic recovery in 3 seconds after peak	.130 ± .091	.050 ± .104
Galvanic reaction to the conditioned stimulus	.109 ± .091	.063 ± .103
Blood-pressure reaction to the conditioned stimulus	.001 ± .095	.537 ± .074* (.232 ± .099)

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* Elimination of one case reduced the correlation with recorded arm movement in groups III–IV to −.107 ± .108; and with blood-pressure reaction to the conditioned stimulus, groups III–IV, to .232 ± .099.

and the strength of the shocks where double the standardized intensity was employed is, perhaps, to be expected. The doubling of two physiologically equivalent stimuli does not necessarily result in physiological equivalence. Our observation of this fact was the occasion for changing to the single intensity stimulus in groups III–IV. The reason for not using the single intensity in the first groups was that the single intensity stimulus when delivered for only one-tenth of a second had seemed, to our preliminary judgment, too weak to produce the psychological effects desired.

Other measures for which there appears no relation to the intensity of the shocks were: per cent galvanic reaction to the non-conditioned stimuli; immediate galvanic reaction to the warning; immediate blood-pressure reaction to the warning; per cent resistance change in 2 minutes following warning; spontaneous galvanic reactions during 2 minutes of anticipation of the shocks; decrease in galvanic reaction to successive electric shocks; recovery-reaction quotient; percentage of association of reaction to the conditioned stimuli (clicks) in relation to the conditioning stimuli (shocks); extinction of the conditioned reaction; and increase in resistance during 2 minutes of rest after stimulation.

The measures of simple reactions of galvanic, blood-pressure, and muscular change for the single-intensity shocks does not give evidence of failure to achieve psychological equivalence of stimuli.

ABSOLUTE AND PER CENT RESISTANCE CHANGE

The importance of evaluating changes in resistance in relation to the preceding level of resistance, rather than treating it as of significance in itself, becomes evident when we attempt to compare the reactions of different individuals. An attempt to compare directly, or to plot on an absolute scale, the reactions of subjects having greatly different levels of resistance shows great discrepancies between subjects who are apparently manifesting the same amount of psychological and physiological reaction under the identical stimulating conditions. For example, subject No. 31, Figure 4, at a resistance level of 80,000 ω gave reactions of from 6,000 ω to 7,000 ω in response to electric shocks, while subject No. 30 at 6,000 ω gave reactions of about 1,500 ω magnitude. Comparing the absolute magnitude of reaction would indicate about four times as great physiological reactivity for subject No. 31 as for subject No. 30. But judged by other criteria, subject No. 30 was considerably more disturbed under stimulation, as indicated by data given in italic figures in Table 86.

The lower resistance of subject No. 30 might in itself be presumptive of his greater reactivity, inasmuch as the correlations of Table 77 indicate that excitability and also paranoid tendencies are likely to be associated with low resistance. Furthermore, the correlations of Tables 6 and 44 show that persons with low resistances typically manifest the larger motor reactions under excitation, and, at the same time, require less than the average current for motor standardization of the electric shock. It follows that we might expect the galvanic reactions of persons with low resistance—assuming that the galvanic response is in any sense an index of general reactivity—to be greater for persons with low than for persons with high resistances. This is *very decidedly not* the case when changes in absolute resistance values are compared. When resistance changes are translated into relative values by calculating the percentage of resistance change, or by plotting the changes on a logarithmic scale, the values for reactivity conform well with what might be expected according to the other indices of reactivity. That other investigators have appreciated the necessity for this treatment of the data should make this extensive argumentation unnecessary. Cattell (1920), Slight (1929), Brown (1915–16), and others of the English school have considered it essential. The evidence offered by Lauer (1929) should be quite conclusive. And yet a large amount of would-be "controlled" investigation is carried on without regard for these considerations. In many instances the experimenters have not even troubled to ascertain the values of the changes in standard units, but have contented themselves with reading deflections on a dial.

TABLE 30

	Subject No. 17	Subject No. 40
Average resistance level preceding six shocks	80,100.00	6,733.50
Average reaction to six shocks	7,441.70	1,633.50
Per cent galvanic reaction to six shocks	8.3	21.8
Average blood-pressure reaction (millimeters of deflection) to six shocks	0.42	4.06
Average recorded arm movement (millimeters of deflection) six shocks	2.90	8.52

In consideration of these facts it is not at all surprising that investigators of the "psychogalvanic" reflex who have been content merely to get observable but electrically non-quantitative changes from an apparatus having a fixed sensitivity and a fixed internal resistance should obtain confusing and even contradictory results when they attempt to compare the results obtained from different individuals. Quite obviously, if the resistance of the galvanometer is high and the resistance of the subject is low, the effects in terms of measured deflections on a linear scale, or in numbers of measurable reactions per unit of time, are not going to be as great as if the resistance of the subject more nearly approximated the resistance of the galvanometer. In like manner, if the resistance of the galvanometer is low and the resistance of the subject is high, the comparison of the deflections of such a subject with those of one having a resistance that is low can have little value. We are convinced that only quantitative electrical measurements can have much value for the comparison of subjects of different initial or basic resistances, and that only by the treatment of resistance changes relative to the general level of resistance at which the reaction occurs (for instance, by the use of "*per cent* resistance change") are the effects of the same stimuli on different subjects comparable. Certainly, only records in standard units are going to be of much use for comparison of the work of different investigators.

THE METHOD OF MEASURING RESISTANCE

We have employed a modified and somewhat improved form of the Behavior Research Resistance Box which has been previously described (Darrow, 1930).[1] Ordinarily, the use of the Wheatstone bridge requires rebalancing for each reading. When this is undertaken with a subject whose electrical conditions are actively changing, the subject's resistance will have been altered before the new balance can possibly be attained. Furthermore, when a subject changes—say from 50,000 ω to 15,000 ω, as sometimes happens—the total resistance in the circuit is so greatly altered that the amount of current flowing through the galvanometer is changed, the polarization of the skin is altered, and the shape of the curve is affected.

By the use of the Behavior Research Resistance Box these difficulties are overcome. In the form for use with the string galvanometer illustrated in Figure 7 the box consists essentially (1) of a standard bridge, (2) of a high resistance which may be substituted for the subject in the circuit, (3) of a calibrated variable high resistance, which may be placed in series either with the subject or with the substitute resistance. The series resistance performs two services: (1) it permits making a standard scale of additions and subtractions from balance in 1,000 ω, or 10,000 ω steps at the beginning and the end of each subject's record, these deflections to be used as a measure for reading the changes in the subject (see beginning and end of record in Figure 1); and (2) it permits compensation, by simple addition or subtraction of known resistances in series with the subject, for changes in the subject's resistance which otherwise would throw his record out of the recording range. The initial setting of the bridge is not altered in the course of the experiment. The reading of the bridge, the original series resistance, and all changes in the series resistances are, of course, noted in order that the record may later be interpreted.

The photographic strip from subject No. 61, Figure 1, shows a typical record with the original calibration, and compensations for changes in the subject's resistance of the sort described above. This record has been cut at the points where compensating resistance was introduced and the record as a whole has been displaced by the amounts of the compensation (5,000 Ω) in order that the subject's electrical record might be shown as a continuous change.

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[1] A further improvement of the Behavior Research Resistance Box, providing uniform current through all subjects and automatic balancing of the bridge, is described in "Uniform Current for Continuous Standard Unit Resistance Records," *Jour. Gen. Psychol.*, 1932 (in press).

At the beginning of the record the bridge reading was 90,000 Ω. This was balanced (with the string in the center of the record) against 40,000 Ω series resistance plus 50,000 Ω resistance substituted for the subject. Altering

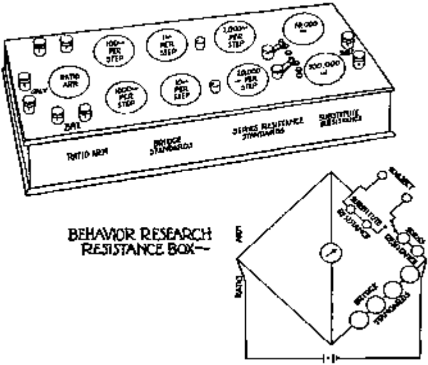

FIG. 7.—Behavior Research Resistance Box (1930 modification)

the 40,000 Ω series resistance by 1,000 Ω steps in either direction gave the scale of calibration which begins and ends the record. In the beginning, after recording the scale of calibration, the substitute 50,000 Ω resistance was replaced by the subject. The first section of the record with the subject in the circuit, reproduced in Figure 1, shows the shadow of the string displaced downward from the position of balance, indicating that the subject's resistance was greater than the 50,000 Ω substitute resistance which he replaced. The scale of calibration indicates that the string occupied this position when the 40,000 ω series plus the 4,000 ω additional series resistance, plus the 50,000 ω substitute resistance, was in the X arm of the bridge. The 40,000 ω series resistance was still in the circuit with the subject at the time of taking the record, therefore the subject's resistance equaled 90,000 ω − 40,000 ω + 4,000 ω, or 54,000 ω.

After the first shock the subject's resistance greatly decreased, threatening to carry the shadow of the string off the record. To prevent this, 5,000 ω was added to the series resistance, bringing the string downward on the record. The record has been displaced one 5,000 ω deflection upward at this point in order to give continuity to the electrical changes. Under these conditions, if the string were at the position of balance in the center of the record, the subject's resistance would equal 90,000 ω − 45,000 ω, or 45,000 ω. But the string at the peak of the reaction is in a position shown by the calibrating scale to be 6.2 thousand ohms less than balance. The subject's resistance, therefore, equaled the 90,000 ω − 45,000 ω − 6,200 ω, or 38,800 ω.

RELATIVE BLOOD-PRESSURE READINGS

For continuous records of blood pressure we may not use pressures in the blood-pressure cuff above the systolic or below the diastolic pressures of the subject, since anything above the systolic would cut off the blood supply to the part examined, and pressures below diastolic would not be sufficiently influenced by changes in the subject's blood pressure to give satisfactory records. Obviously, the application by the rubber cuff of a continuous pressure within the pulse-pressure range of the subject may indicate changes in the subject's blood pressure, but can tell us nothing of the absolute systolic and diastolic blood pressures. These may only be ascertained by an interpretation of the effects on the pulse wave of this externally applied pressure. The best we can do, therefore, is to interpret our records as indications of the direction and magnitude of blood-pressure change. These changes have in this investigation been read merely as changes in deflections on the record — no attempt being here made to translate these values into changes in millimeters of mercury. In an earlier investigation we attempted to calibrate the deflections of our blood-pressure pointer in absolute terms of millimeters of mercury, but we suspect that the method gave the appearance of an accuracy and a degree of standardization beyond that justified by the facts.

In this study, therefore, we have merely read our records in terms of the millimeter deflections of the pointer on the record. This, we recognize, is highly unsatisfactory; and in consequence of the crudity of this measure the blood-pressure changes do not lend themselves to the methods of analysis afforded by the galvanic technique. Apparatus now under construction will, we hope, eventually remedy this difficulty. The readings here reported are made according to the same technique described for an earlier investigation (Darrow, 1929 [3], p. 269).

RELATIVELY NON-POLARIZING, CONSTANT-MOISTURE, CONSTANT-PRESSURE, CONSTANT-AREA ELECTRODES

The comparison of the electrical resistances of different individuals requires careful control of conditions at the electrodes. An electrode suitable for our purposes should be easy of application, should be relatively non-polarizable, and must represent a relatively constant pressure, constant area of contact, and constant moisture. Non-polarizable electrodes of the liquid type are often unsuitable either (1) because of difficulty of attachment of types representing constant area or (2) because of difficulty of controlling and keeping uniform for different-sized hands the area of immersion in the finger-immersion types. Simple zinc-sulphate kaolin-paste, zinc-plate electrodes are objectionable for prolonged records because of the drying of the paste and because of differences in the sensitivity of the skin of different subjects to the zinc sulphate. Even when zinc sulphate of "physiological" concentration mixed with kaolin is employed, some subjects manifest cutaneous irritation. Contacts with the skin made with physiological saline obviate this difficulty. Saline alone, however, enormously increases the polarization and, therefore, the apparent resistance of the electrodes, no matter what metal is in contact with the electrolyte.

To overcome these difficulties, a combination of the saturated zinc-sulphate kaolin-paste on a zinc electrode with a protecting layer of absorbent cotton soaked in physiological saline next the skin has been found satisfactory. Absorption and drying of the saline is compensated by a supply led to the center of the cotton either from a toy balloon filled with 9 per cent sodium chloride or by a short absorbent cotton wick leading to a reservoir beneath the hand.

Constant pressure of the respective electrodes against the hand is maintained by a head of water supplied from a rubber bag which can be raised to a fixed height after the subject's hand is in place. The pressure is transmitted through balloons to the backs of the two electrodes. A more detailed description of an electrode of this type is given under separate title (Darrow, 1932).

AN ATTEMPT TO MEASURE EMOTIONAL TRAITS IN JUVENILE DELINQUENCY

By Carney Landis

INTRODUCTION

That the chief factors leading to juvenile delinquency are social maladjustment (poverty, etc.) and low-grade intelligence is obvious. However, these two classifications do not constitute the entire story. Psychopathic personality, emotional conflict, "nervousness," incorrigibility, emotional instability, etc., are terms used to describe a type of motivation in delinquency occurring in certain cases in which all other factors seem well adjusted. The term "psychopathic personality" is one which occurs frequently in both psychiatric and psychological literature today. It is an ill-defined term, used to describe the child or individual whose reactions are comparatively unpredictable, who seems to lack self-control, who does not conform to the usual social customs—in short, one whose reactions deviate widely from the normal without apparent cause. The term "psychopathic personality" is attached to a wide range of personality difficulties. There is no real reason to believe that there is any one factor motivating all varieties of these deviations, or that there is anything in common between many of the exhibitions of this type of personality other than abnormal deviations of behavior. For the most part, the psychologist has been unable to do very much in the way of analyzing, or even adequately describing, this type of personality. We have tried to objectify our descriptions of human behavior, but usually these objectifications of emotional traits have been unsuccessful.

Among the measures or "tests" which have been described as having more or less value in the analysis of psychopathic or emotional behavior, one may list the Pressey X-O Test, performance on the pursuitmeter, psychogalvanic reflex, Thurstone's Personality Schedule, the Allport A-S Test, tests of the sense of humor, introversion-extroversion tests, performance on maze-learning tests, and suggestibility. Although these tests have been used, there has been little or no effort made to evaluate them, either in terms of their relative value, validity, or reliability.

Bearing this in mind, it seemed worth while to make a critical study of these tests with the hope that the tests themselves might be evaluated and that new methods might be devised which would be of service in dealing with the measurement and objectification of emotional or psychopathic traits.

These experiments were conducted on two discrete groups of subjects. The tests and experimental procedures were different with each group. In reporting this entire investigation the following plan will be used. Part I will deal with the first series of tests given at the Chicago Detention Home. Part II will be concerned with the tests given at the Long Lane Farm. The general findings from both Part I and Part II will be brought together and discussed under the heading "Conclusions."

PURPOSE OF THIS STUDY

Since no comparative evaluation of the various methods of testing or measuring emotion, emotional instability, or emotional psychopathy had been made, it seemed worth while to make such a study. Situations should be arranged which might lead to a certain amount of emotional disturbance during which various measures might be made. Various paper and pencil tests should be assembled and administered to the same subjects. The subjects should be so chosen that histories and other social data from their past life might be available. All of these test results should be intercorrelated, and the results from each particular test compared in as many ways as possible so that as many relationships or lack of relationships between the various tests might be demonstrated.

PART I

A STUDY OF 100 DELINQUENT BOYS

METHOD

SUBJECTS

The subjects in Part I were 100 boys who were, for various reasons, held at the Detention Home of the Juvenile Court in Chicago. The ages were as follows: 124–39 months, 4 boys; 140–49, 3; 150–59, 9; 160–69, 14; 170–79, 21; 180–89, 21; 190–99, 21; 200–207, 7. All of these boys were American-born, but many of them were first-generation American. For the purposes of this study they were grouped by the nationality (birthplace) of the parents, since the home life was undoubtedly different for the different nationalities. There were 13 Negroes, 8 Germans, 8 Lithuanians, 27 Polish, 9 Italians, 25 Americans (other than first-generation Americans), and 10 other nationalities. Fifty-three of these boys were held for some variety of theft, burglary, petty larceny, breaking into houses, etc.; 18 for running away from home; 10 for truancy; 8 as incorrigible; and 11 for other reasons.

TESTS

a) Personality Schedule.—Thurstone's Personality Schedule (1930) was taken as a basis for a questionnaire for this group. The original schedule was designed for college students. It consists of a list of several hundred questions, which are designed to demonstrate or elicit information concerning personality difficulties or deviations. The original schedule was not, for several reasons, adapted to our purposes. It contained many questions applicable to older age groups than we were using; it contained many words with which our group was unfamiliar, and contained questions which, in our opinion, would give little or no information concerning the traits in which we were interested. For this reason we selected 147 of the questions, and expressed each in terms which we believed would be intelligible to the group with which we were working. Each question was answered "yes," "no," or "?". The first three questions are given as examples:

(1) Yes No ? Do you like to play alone?
(2) Yes No ? Do you get mad easily?
(3) Yes No ? Have you always been a good
friend of your mother's?

b) Allport Ascendancy-Submission Reaction Study (Allport and Allport, 1928).—Like the Personality Schedule, the questions constituting this test were designed for college groups, and hence modifications were necessary for our group. We used 27 of the 33 items of the test, carefully re-wording each question so that it might apply to situations with which each of these boys was familiar and make use of words which these boys could understand. A sample of our revision of the test is given in the following two questions:

1. In watching a game of football or baseball in a crowd, do you make remarks (funny, cheering, razzing, or otherwise) which can be heard by those around you?

Lots of times ______________________________
Sometimes __
Never ____

. At a movie, if you arrived after the show has started, and find that there are people standing, but also that there are front seats available which might be secured by going up to these, do you take the seats?

Always ______________________________
Sometimes ______________________________

c) The Almack Sense of Humor Test (Almack, 1928).—Through the courtesy of Professor Almack we were able to obtain copies of a test of the sense of humor which he has devised and standardized. This test consists of three parts: Part I is constituted by 12 drawings, illustrative of humorous situations. According to the directions, each picture should be marked with ×× if the subject considered it very funny, with × if he considered it fairly funny, and with a o if he thought that it was not funny at all. The second part consisted of 34 jokes which were marked in the same way as the first part. Part III consisted of 50 names which ranged from the humorous characters of classical literature to the comedians of the movies and of the newspaper comic strips. The subject was asked to mark out the names with which he was not familiar, and then to mark with ×× , ×, or o the remaining names.

d) Pressey X-O Test (*Form B*) (Pressey, 1921).—This test was used as it is prepared. We found, through experience, that it was practically impossible to obtain any meaningful results with this test on boys younger than 13 years or below the seventh grade of school. For this reason, this test was given to only 74 of our 100 subjects.

These four tests were used because it seemed that each gave an approach to certain personality traits which, if taken in combination, might give some indication of the factors involved in emotional instability which we wished to measure. The Personality Schedule, it seemed, should give us a picture of the difficulties which the individual found in adjusting to everyday life. The Ascendancy-Submission Test might bring out points concerning the way in which the individual was meeting difficult situations. Sense of humor is a character trait which has not received any marked attention from the experimentalist but one which should enter into any character analysis. What an individual considers as humorous is certainly as revealing of his personality as the things which frighten or worry him. The Pressey X-O Test gives a measure of the number of likes and dislikes of an individual, and a measure of the conformity of an individual to the dislikes and worries, or interests, of his group.

Certain other tests, such as the Will-Profile Test, Social Attributes Test, Free Association Test, etc., were considered, but finally omitted from this program, since they did not adapt themselves to the age group, or social status of the boys with whom we were working.

APPARATUS

Pursuitmeter.—A Weiss-Renshaw pursuitmeter,[2] consisting essentially of a moving electrical point with which a stylus must be kept in contact, was used in this experiment. When the contact is broken, the apparatus stops, and may only be started by remaking and holding the contact. This electrical point was driven by a series of gears and lever arms to form an exceedingly intricate design, covering some 10 or 12 square inches. The pattern was unlearnable under the conditions of our experiment. The speed of movement was irregular and maintained at a pace which was difficult to follow. Each subject was instructed as follows: "See this brass point and this other bright point on this handle? So long as you keep these two points together this apparatus will run. If you press down too hard the apparatus will not go. Hold the handle lightly on the contact, and, as you see, the apparatus will run. Your job is to keep this machine going." After some experimentation it was found that working the subject continuously for 20 minutes, then resting 2 minutes; working 10 minutes, resting 1 minute; and finally working 10 minutes, constituted an optimum experimental seance. In such a seance the range of fatigue and emotional disturbance varied widely from subject to subject. The conditions of work were held rather rigidly constant. The subject was alone in the room with the experimenter, and conversation was not allowed except during the rest periods. The subject was not allowed to slacken on the job, and was directed to work as hard as possible at all times.

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[2] The pursuitmeter, stabilometer, and recorder are described by Renshaw and Weiss (1930).

Stabilometer.—The subject was seated on a stool, the seat of which was movable in any direction for approximately an inch and a half. These movements were made as easily as one might move a rocking chair, so that the subject could readjust his posture easily at any time during the experiment. All movements of this movable seat were recorded by a simple flash apparatus, so that the number of movements might be counted; but no account could be taken of the direction or extent of movement. This apparatus had several limitations. It was not highly sensitive, rotary movements about the center were not recorded, and it occasionally stuck in certain positions. The records of postural adjustments are not as exact as one might wish.

Psychogalvanic reflex.—For this experiment we made use of the tachogram method of Godefroy (1922). The subject was connected in series with the positive terminal of six dry cells and one pole of the primary winding of a "one-to-one" transformer. The other side of the primary winding was connected to the negative terminal of the battery. A moving coil galvanometer was connected directly with the secondary winding of the transformer. With this arrangement any change in the resistance, polarization, or electrical output of the skin would cause a change in the electrical flow through the primary of the transformer. This change would induce a current in the secondary winding of the transformer, which would be shown by the galvanometer. The method has the advantage of simplicity in action and of absence of the necessity of time-consuming balancing with a Wheatstone bridge. We proposed to use a constant E.M.F. of 9 volts, but found that with certain subjects a current of this strength produced pain and blisters. Whenever a subject complained of the painful sensation, the voltage was decreased, so that 9 volts were applied to 75 subjects; 7½ volts to 2 subjects; 6 volts to 16 subjects; 4½ volts to 2 subjects; 3 volts to 4 subjects; and 1½ volts to 1 subject. The question of the relation of the voltage to the electrical reaction will be discussed later. The electrodes consisted of two zinc cups 1 inch in diameter and ¼ inch deep. These cups were filled with a paste made of kaolin and physiological saline. The electrodes were attached one to the palm and one to the back of the left hand (except in cases of left-handed individuals, when the attachment was made to the right hand). The electrodes were held in place by a gauze bandage wrapped securely about the hand. It was found that the drying of the electrodes during the 45 minutes of this experiment was not sufficient to cause any marked electrical differences.

Recording.—A Weiss-Renshaw polygraph was used to record the performance of the subject on the pursuitmeter, the stabilometer, the number of electrical responses, and the time in seconds. The pursuitmeter record showed the number of times a contact was made or broken between the stylus and the moving electrical point, together with the amount of effective work done by the subject. The stabilometer record showed the number of gross bodily movements of the subject.

For the record of the electrical responses the experimenter observed the excursions of the galvanometer and closed a recording key with every excursion, so indicating an electrical change on the part of the subject. No special effort was made to have this record indicate more than the simple fact that a reaction had occurred. Little attention was paid to the duration or extent of the responses, since our interest was primarily in the frequency. This method is not as satisfactory as it might be, since it is difficult for any observer to concentrate his attention for 40 minutes on a moving point of light and to record all of the excursions. One cannot avoid lapses of attention which result in a failure to record a few excursions. We had hoped to use a sensitive electrical relay for this recording, so that responses of the skin would be recorded directly through the relay to the polygraph. However, variations in the excursion of the galvanometer are often due to movements of the hand to which the electrodes are attached, to scratching of the electrode-hand with the other hand, gross bodily activity, etc., all of which may be discounted by the observer but which are recorded when a relay is used. We consider, therefore, that the use of the observer, while not ideal, gives a fairly faithful record of the frequency of these electrical changes.

SCORING METHODS[1]

Personality Schedule.—Each question of the Personality Schedule was considered separately; and if, in the opinion of the writer, the answer of "yes" would indicate an emotional trend, that answer was scored "one" (1), while answers not indicating emotionality were scored "zero" (0). The total score indicates the relative degree of emotionality of the subject. A second or conformity score was obtained by tabulating all answers to all questions for all subjects. From this a key was constructed in which any answer given by more than 60 per cent of the group was scored as 0 and all others as 1. This method of marking changed the scores somewhat from the emotionality scoring but did not reveal anything of importance.

Sense of Humor Test.—Dr. J. C. Almack kindly furnished us with a key which we used for scoring this test. A second or conformity key was constructed on the basis of the tabulated data. In this conformity key unusual answers were weighted heavily in comparison to usual answers.

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[1] The original scores and classifications for Part I will be found in Appendix A, pages 318–20.

A-S Reaction Study.—This test was scored in three different ways, which will be referred to as "Allport scores," "Landis scores," and "Conformity scores." The Allport score is based on the weightings given by the manual of directions supplied with the test, omitting the scoring for the questions which we omitted. The Landis score is one which was arbitrarily constructed by weighting each answer according to the degree of emotionality which the writer felt was indicated by the answer given. The Conformity score was obtained by tabulating all answers given by our group of boys and weighting proportionally the answers deviating from the median in accordance with the degree of their deviation. Thus, an answer which occurred only 5 times in 100 would be weighted as 10, while one occurring 60 times in 100 would be weighted as 1.

Pressey X-O Test.—The Pressey Test is scored in two ways: (*a*) for emotionality, i.e., the total number of words crossed out by the subject taking the test; and (*b*) idiosyncrasy, i.e., the number of encircled words which deviate from a list of preferred words obtained in the original standardization of the test. The key for the original idiosyncrasy scoring did not seem to fit this particular group. Hence we tabulated all answers given on this Pressey Test and constructed an idiosyncrasy scale making the modal word in each series the correct answer. This conformity scoring changed the results markedly for this particular test.

Pursuitmeter.—The score for the pursuitmeter performance was obtained by counting the number of contacts made during each minute of performance. This figure is expressed in the tables as errors per minute.

Stabilometer.—The score for the stabilometer is given in the tables as the number of movements per minute made by the subject. The errors and limitations of this particular score have been discussed.

Psychogalvanic reflex (frequency).—The number of electrical responses appears in the tables expressed as deviations per minute.

The range is large, since in a few cases no electrical response was elicited, and in certain other cases the electrical changes appeared with great rapidity.

Psychogalvanic reflex (latency).—An additional measure given by these electrical changes is that of the latency of the first appearance of the reflex in each portion of each experimental seance. The number of seconds, elapsing between the time at which the subject started to work on the pursuitmeter in each period of the experiment and the appearance of the first electrical response, is given in the tables below under the heading of "Latency, First Period"; "Latency, Second Period"; "Latency, Third Period." This particular score should (theoretically) offer a measure of the relative stability of the subject, if the electrical responses are to be regarded as a sign of emotional disturbance.

Psychogalvanic reflex (relation to pursuitmeter and stabilometer records).—That these electrical responses would tend to appear in some definite relationship to postural activity or performance on the pursuitmeter seemed to be a reasonable a priori assumption. It seemed that the outlet for such exasperation as might result from the difficulty of performance would show itself either as bodily activity, as an increase in the number of errors on the pursuitmeter, or as a series of electrical changes of the skin. A comparison of the frequency of electrical responses, performance, and postural activity is given in Table 1. The classification of pursuitmeter records into "good," "bad," and "indifferent" was made as follows. When an electrical response occurred while the subject was running the pursuitmeter without error, it was classified as "good." When the subject was, or just had been, making a series of errors, the record was classified as "bad." In cases where it was impossible to be sure whether the record should be called good or bad, it was classified as "indifferent." Electrical responses which occurred during or immediately after movements recorded by the stabilometer were classified as active. The electrical responses occurring while no movements were recorded by the stabilometer are classified as passive.

Weather.—During this experiment, I had the impression that on certain days most subjects in the experiment either gave a high frequency of electrical responses or failed to show electrical reactions. No good reason for this seeming grouping was apparent, since the nationality, age, physical condition, etc., were quite varied. It did seem that the weather might have some influence on these electrical changes, and for that reason the official temperature, barometric pressure, and humidity were obtained from the Chicago weather bureau. It is obvious that this official temperature bore no relation to the actual temperature immediately surrounding the subject, since on some days the room was heated, while other days the windows were open and outside temperature existed within the room. The barometric pressure is probably fairly accurate, since the variations in pressure throughout the locality were not particularly marked. The humidity records were not completely satisfactory, as the weather bureau records were taken every 2 hours, so that part of our figures are interpolated.

Relationship between the Occurrence of the Psychogal Reflex and the Performance on the Pur- on the Stabilometer

	No. of Errors per Minute on Pursuitmeter											
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Good	83	33	41	32	30	19	16	14	21	15	0	4
Bad	13	35	27	41	51	63	76	67	59	60	94	85
Indifferent	4	32	31	27	20	18	8	20	20	25	6	11
	Percentage of P.G.R.'s Which Occurred When Stabilometer Was—											
Active	2	10	3	4	17	15	22	20	19	1	0	19
Quiet	98	90	97	96	83	85	78	80	81	99	100	81

"*Educational quotient.*"—No opportunity was afforded for the obtaining of intelligence tests upon all of our subjects. We did obtain the grade-placement in the public schools for each subject in this series. From these grade-placement records, together with the known age of the individual, it was possible to obtain an "educational quotient" (E.Q.) by dividing the grade-placement expressed in months by the age expressed in months. This measure is subject to certain errors, since some of the boys included in this study were from other cities which do not have comparable school systems, since others had quit school and were working before being brought to the Detention Home, and since still others were in special classes. An attempt was made to take account of these factors, and an approximate E.Q. was assigned on the basis of the social history available. We feel that this figure, although not nearly so accurate as that afforded by an intelligence test, gives a rough relative ranking of the intellectual status of the group with which we were dealing.

Correlations.—The results of our experiment were tabulated, and the intercorrelations (Pearson product-moment formula), given in Table 2, were obtained. These correlations are based on the original scores. That is, the sense of humor score is that given by the use of Professor Almack's key. The A-S (Allport) and A-S (Landis) are the scores based on Allport's key and on our original emotionality key. The Pressey Idiosyncrasy score was that obtained from the use of the original Pressey list.

Age.—Referring to Table 2, it will be noted that age shows an average correlation of .10 with the other tests used here. (Average correlation means the arithmetic mean of the correlation figures added without regard to the plus or minus sign.) The correlation of −.36 with the Personality Schedule indicates a very slight tendency on the part of the older boys to answer the questionnaire with unemotional answers more often than do younger boys.

"Educational quotient." The educational quotient has an average correlation value of .17. The correlation of +.33 with the Sense of Humor Test indicates slightly that schooling is necessary to appreciate the jokes used in the test. The correlation of −.39 with the Pressey Idiosyncrasy Indicates that the boys who are

TABLE 2

INTERCORRELATIONS BETWEEN THE MEASURES APPLIED IN PART I OF THIS EXPERIMENT

	Age	"E.Q."	Almack	A-S (Allport)	A-S (Landis)	Personality	Voltage	P.G.R. Frequency	P.G.R. Latency, First	P.G.R. Latency, Second	P.G.R. Latency, Third	Pursuitmeter	Stabilometer	Temperature	Barometer	Humidity	Pressey Emotivity	Pressey Idiosyncrasy	Average Correlation Values
No. of cases	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	74	74	77
Age		−.08	+.10	+.11	+.02	−.30	−.06	+.03	×	×	×	−.01	−.03	×	×	×	+.11	−.10	10.4
"E.Q."			+.33	+.11	−.12	−.13	×	+.04	×	×	×	−.12	−.19	×	×	×	−.18	−.39	17.7
Almack				+.02	−.00	−.14	×	+.36	−.01	−.25	−.13	−.11	−.10	−.06	−.11	+.09	−.14	−.31	12.3
A-S (Allport)					+.02	+.06	×	+.09	−.04	+.01	+.10	+.06	−.17	+.14	+.16	−.01	+.19	−.13	8.9
A-S (Landis)						+.18	×	+.10	−.05	+.00	+.04	−.10	−.02	+.25	−.09	−.04	−.12	+.18	11.6
Personality							×	−.00	+.02	−.10	+.09	−.15	+.09	+.30	−.08	+.11	+.20	+.17	10.5
Voltage								+.43	−.35	−.05	−.08	×	×	+.13	−.38	+.18	−.02	−.06	12.8
P.G.R. Frequency									−.36	−.35	−.33	−.06	−.05	+.30	−.08	+.04	+.07	−.06	12.2
P.G.R. Latency, first										−.07	−.47	+.07	+.12	+.01	−.03	+.00	+.06	+.01	9.9
P.G.R. Latency, second											+.13	+.01	+.05	−.06	+.11	+.07	−.06	+.21	13.0
P.G.R. Latency, third												−.06	+.07	−.05	+.14	−.12	−.01	+.09	7.4
Pursuitmeter													+.18	+.04	+.12	−.00	−.04	+.11	8.6
Stabilometer														−.17	+.18	−.15	+.07	+.19	11.7
Temperature															−.22	−.38	+.05	+.08	11.7
Barometer																−.30	+.07	+.06	10.7
Humidity																	+.05	+.07	8.6
Pressey Emotivity																		+.30	15.5
Pressey Idiosyncrasy																			15.2

more advanced in school tend to conform with the standard of the outside group on whom Pressey standardized the test.

Sense of Humor.—This has an average correlation of .12. It correlates −.25 with "P.G.R. Latency, second period," and with the Pressey Idiosyncrasy −.31. For the first of these correlations no explanation is apparent. The correlation with the Pressey Idiosyncrasy may conceivably be due in part to the effect of the E.Q., since the more intelligent (higher E.Q.) boys scored high on the sense of humor and low on the Pressey Idiosyncrasy.

A-S (Allport).—The A-S Test scored by the Allport key had an average correlation of .09. It does not correlate significantly with any of the other factors in this array of figures.

A-S (Landis).—This test, when scored for emotionality, shows an average correlation of .12. It correlates +.25 with temperature and +.18 with the Pressey Idiosyncrasy. The first correlation can only be due to chance; the second might conceivably indicate that there is a slight tendency for some common factor to be operating in both tests.

Personality Schedule.—This test shows an average correlation of .11. It rather surprisingly correlates only +.20 with Pressey Emotionality Test. A priori, one would expect a rather definite relation between the number of words which would be struck out in the Pressey list and questions which would be answered in an emotional fashion on the Personality Schedule.

Voltage.—Voltage gives an average correlation of .13. It correlates with the P.G.R. Frequency +.43 and with the P.G.R. Latencies −.25, −.08, and −.08. Evidently, the higher the applied voltage the greater the frequency of the appearance of this electrical response and, conversely, the more rapid the occurrence of the appearance of the first electrical response in the first work period. The interrelationship between these factors will be discussed in greater detail below.

Psychogalvanic Reflex; Frequency.—This gives an average correlation of .12. It correlates with the P.G.R. Latencies −.36, −.25, and −.33. These relationships will be discussed more fully below. *Latency, first period:* The average correlation here is .10. The correlation of −.47 with P.G.R. Latency, third period, will be discussed below. *Latency, second period:* The average correlation value here is .13. The correlation of +.21 with the Pressey Idiosyncrasy is probably due to chance. *Latency, third period:* The average correlation value here is .07. It shows no correlations of interest other than those mentioned above.

Pursuitmeter.—The average correlation of pursuitmeter performance with all the other factors is .09. The correlation of +.18 with activity on the stabilometer is one which might be expected to be much higher.

Stabilometer.—This factor gives an average correlation of .12. The correlations with temperature, barometer, and humidity of −.17, +.18, and −.15, respectively, are rather interesting but not high enough to be of the slightest significance.

Temperature, barometric pressure, humidity.—The average correlations for these three factors are .13, .12, and .09. These factors correlate with each other rather well, but do not offer correlations of interest other than those discussed above.

Pressey Emotionality Test.—This test has an average correlation of .16 but, other than its correlation of +.36 with Pressey Idiosyncrasy, it gives no correlation which is of significance. It is doubtful that even this correlation means very much, since in an earlier study reported by Landis, Gullette, and Jacobsen (1925) on 124 subjects, a correlation of −.02 was obtained between the two scorings of this test. The average correlation of .16 which we obtained here corresponds identically with the average correlation value reported in the previous study.

Pressey Idiosyncrasy Test.—This test had an average correlation of .15.

Partial correlations.—Since it seemed that the factors of "voltage," "P.G.R. Frequency," "P.G.R. Latency, first," "P.G.R. Latency, second," "P.G.R. Latency, third," "temperature," "barometer," and "humidity" might have certain elements in common, partial correlations were worked out for these eight factors and are given in Table 3. This table shows that the correlation between each of the two factors with all other six factors kept constant was not raised or lowered significantly. The multiple correlation between voltage, P.G.R. Frequency, and P.G.R.

Latency, first, was +.44. These partial and multiple correlations indicate (1) that the applied voltage is a factor of importance in the appearance of the electrical responses and (2) that environmental temperature, humidity, and barometric pressure have nothing to do with the appearance of the electrical responses.

Non-linear correlations.—One object of this study was to test the validity of the use of the psychogalvanic reflex as an indicator of personality traits. In order that a full analysis of this might be made, we computed the non-linear or skew correlations ("η formula") (Pearson, 1905) between the frequency of the appearance of the reflex and the performance on the pursuitmeter, the Personality Schedule, Pressey Emotivity, and the A-S (Allport). These correlations may be tabulated as in Table 4. It is apparent both from the η figures and from the scatter diagrams that the reflex did not give a linear distribution. Its regression line had the form of a letter S turned through 90° to the left. However, the probable error of all the η figures is such that only those figures above .30 have any significance, and the .34 has only 55 chances in 100 of being better than chance.

TABLE 3

TABULAR STATEMENT OF THE PARTIAL CORRELATIONS BETWEEN EIGHT MEASURES

Each figure represents the correlation between two factors when six other factors held constant.

	P.G.R. Frequency	P.G.R. Latency, First	P.G.R. Latency, Second	P.G.R. Latency, Third	Temperature	Barometer	Humidity
Voltage	42	— 28	— .04	— 04	10	— .08	.15
P.G.R. Frequency		— 40	— 37	— 32	18	— .07	.02
P.G.R. Latency, first			— 06	— 48	01	— .01	.05
P.G.R. Latency, second				— .13	00	.12	.15
P.G.R. Latency, third					— 07	00	— 08
Temperature						— 24	— 43
Barometer							— .20

Tabulation of test items.—It has been mentioned that psychopathic personality is usually considered as a variety of nonconformity behavior. For this reason all items of the paper and pencil tests were tabulated and rescored, as has been explained above. The Sense of Humor Test gave some rather interesting points with this rescoring. There was a marked tendency for almost every joke to obtain about an equal score for goodness. In the case of only three or four jokes was there any pronounced like or dislike on the part of a majority of the subjects. The differential score obtained by this conformity scoring method was found to depend almost entirely upon Part 3 of the test, which consists of a series of names of newspaper "comic-strip" characters, motion-picture comedians, and humorous or semi-humorous authors of the world's literature. Most of the group with which we were dealing were familiar with some of the comic-strip characters and two or three motion-picture comedians. On final analysis the differential score obtained on this test was based upon the familiarity with comic-strip characters which the subject possessed. This finding invalidates the Almack test of the sense of humor as a measuring device of personality for our purposes.

Correlation between F.G.R. Frequency and—	Linear r	Non-Linear η	
		On F.G.R.	On Other Variable
Pseudometer	− .06	.25	.25
Personality Schedule	− .09	.18	.25
Pressey Emotivity	+ .07	.21	.31
A-S (Allport)... ..	+ .09	.34	.39

The rescoring of the Personality Schedule changed the scoring of 14 of the 147 items. For instance, we had considered that the answer "yes" to the question: "Have you ever bitten your finger nails?" would indicate emotionality, while the unemotional person would answer this "no." As a matter of fact, a majority of our group answered this question "yes," constituting the conformity answer. The same is true of such questions as: "Are you ever nervous?" "Do you have to be careful of your health?" "Do you like to be with other boys a lot?" etc. The rescoring with these conformity changes did not alter the test results very markedly. Changes in rank within the group were common, but there were only two changes of as much as ten places in the ranking of any subject.

The rescoring of the A-S Reaction Study failed to show any very marked preponderance of preference for particular answers to the questions. For this reason our conformity score had an exceedingly small range and gave little of differential value.

The Pressey X-O Test, scored for idiosyncrasy, showed the following changes in the most preferred word in each test. For Test I:

1. begging *changed to* smoking
3. stinginess *changed to* ignorance
4. fibbing *changed to* recklessness
5. boasting *changed to* talking back
7. debt *changed to* bluff
8. war *changed to* kidnapping
9. cad *changed to* toughness
11. divorce *changed to* gang
13. cribbing *changed to* butting-in
14. immodesty *changed to* disgrace
15. snob *changed to* grumbling
16. idleness *changed to* chewing
17. sham *changed to* slyness
25. flunking *changed to* insanity

For Test II the following changes appeared:

[illegible] self-consciousness *changed to* accidents
8. weakness *changed to* death
10. rivals *changed to* police
11. longings *changed to* wrecks
12. reciting *changed to* suffocating
13. lemons *changed to* poison
15. morals *changed to* athletics
16. jealousy *changed to* smoking
19. blushing *changed to* gun
21. health *changed to* dogs
23. disposition *changed to* knives
25. flightiness *changed to* detectives

In Test III the following changes were made:

1. boating *changed to* beaches
5. dancing *changed to* reading
6. talking *changed to* acrobats
9. leaders *changed to* good boys
11. socials *changed to* clubs
12. coffee *changed to* pop
13. sleeping *changed to* typewriting
14. musicians *changed to* aviators
15. Hamlet *changed to* Tarzan
18. sports *changed to* sailors
19. college *changed to* traveling
20. business men *changed to* soldiers
21. doctors *changed to* chauffeurs
24. country *changed to* circuses
25. racing *changed to* fishing

When the test is rescored on the basis of these new items, a marked difference in the ranking within the group was obtained.

After these tests had been rescored, the scores of the subjects for each test were ranked from the highest to lowest. The highest 20 and lowest 20 scores for each particular test, together with the highest and lowest 20 on the P.G.R. Frequency, pursuitmeter, and stabilometer, were compared. We had rather expected to find that this treatment of the data would show that certain individuals tended to be at one extreme or the other in the majority of the tests, while other individuals would fall in the middle group in most cases. This was not true. We found that 4 individuals were in the highest or lowest 20 of eleven of the test scores and that 7 of the individuals were in the extreme groups on as many as six tests. No individual failed to obtain at least one score which would place him in an extreme group. On the basis of this we feel certain that the application of the correlation method to our rescored tests would show exactly the same thing that the correlations did with the original tests, namely, practically no existent relationship between the tests.

There was the possibility that there would be a tendency to certain varieties of answers on these tests by some individuals. The theory here is that an individual showing certain behavior difficulties will answer the question on our test in some way which will be common with other individuals showing the same behavior difficulties. We found no internal groupings which would support this theory.

Relation of psychogalvanic reflex to emotionality.—During the course of our experiment some of our subjects became frightened, nervous, angry, or exhibited other expressions of emotion. Table 5 is a tabulation of the number of individuals in which various behavior deviations (emotional expressions) were noted during the experiment, together with the average P.G.R. Frequency for these individuals. It is interesting to note that in all of the classifications, with the exception of that of "nervous, jumpy," the P.G.R. Frequency is considerably below that of the average of the entire group of 100 subjects. The average P.G.R. Frequency for the entire group was 32 reflexes during the 40-minute experimental seance as compared to 7.6 for 5 frightened boys; 4 angry, 16.7; 3 tired, 13.6; 3 crying, 18.6; and 6 in pain, 13.5. Five nervous, jumpy individuals gave an average of 40.7 P.G.R. reactions. Just exactly what this means, is difficult to say, since it certainly runs contrary to all expectation. On the basis of current psychological theory one would expect that the frightened, angry, or tearful individual, that is, those giving all outward signs of an emotional condition, would give very frequent P.G.R.'s. Instead, we find that they are much less frequent than with the normal.

TABLE 5

SHOWING THE AVERAGE FREQUENCY OF

TYPES OF BEHAVI

Behavior	No. of Cases	Average P.G.R. Frequency
Frightened	5	7.6
Nervous, jumpy	5	49.4
Angry	4	16.7
Tired	3	13.6
Cried	3	18.6
Pain	2	13.5
Left-handed	5	34.6
Entire Group	100	32.0

Five subjects who were left-handed show an average P.G.R.

Frequency of 34, so deviating but slightly from the average of the rest of the group. This offers some check on our comparison of small groups to the entire group.

The P.G.R., when tabulated according to the nationality of the subjects showed little, with the exception of the fact that our 13 Negro subjects gave an average P.G.R. Frequency of 18, compared to the group average of 32. Again, this is contrary to expectation. Common sense has it that Negroes are more emotional and unstable than whites. Our finding is probably partly explained by the difference in the quality of the skin of the palm of the hand of the Negro boys of this group as compared to the white boys. The 13 Negroes with which we experimented had dry, calloused palms. That this is not the entire explanation is apparent, since two of the white boys which we examined had very calloused palms, one from using crutches, the other from working as a day laborer. The P.G.R. Frequency for these 2 individuals was, in each case, very nearly that of the average of the group.

The boys who were held at the Detention Home for "running away from home" show an average P.G.R. Frequency of 48, which is considerably larger than the average of the group. No explanation seems particularly valid on the basis of the data at hand.

The comparison of the P.G.R. Frequency with the paper and pencil tests gives no significant correlations either when compared on the basis of the original scoring or on the basis of the conformity scoring. So far as this experiment went, the P.G.R. did not serve as an indicator of emotionality, judged either on the basis of other tests which are supposed to be measures of emotionality, on the basis of the behavior of the subject during the experiment, or on the basis of the social records which were available for these boys.

Social history.—We were able to secure access to the court records, reports of social investigators, or reports of examinations made by the staff of the Institute for Juvenile Research for 66 of our 100 cases. Since 34 of the boys were released by the police without appearing before the Juvenile Court, no data of this variety was available for them. The social history reports were so varying in form and content that any thoroughgoing system of classification was impossible. We arbitrarily classified each case as one of "social cause," "low intelligence," or "psychopathy," depending on which of those factors seemed to provide the strongest motivating forces leading to the delinquency of the boy. Under "social causes" we placed those cases in which poverty, bad associates, home conditions, or lack of employment seemed to be paramount. By "low intelligence" we typified those individuals whose lack of aptitude for schooling or whose score on an intelligence test was so low as to indicate that the delinquency was due to shortage of intellectual ability. Only two of the cases were rated as low as "border-line feeble-minded." Under "psychopathic" were placed cases exhibiting abnormal behavior without evidences of clearly distinctive social or intellectual causation. Certain of the boys were classified as "non-delinquent," as their record indicated that they were victims of circumstance and could not properly be considered as social offenders. Such boys were held at the Detention Home because of crimes committed by the parents, mistaken identity, and so forth.

From our records, it appears that psychopathy enters into 9 of the cases with which we dealt. These cases may be summarized as follows:

Case No. 1.—A colored boy held for shooting. This boy had an extended court record and had received several mental examinations. He was showing clearly the effects of mental deterioration and has since been committed to an asylum. His score on the Personality Schedule was in the 80th percentile, the Pressey Idiosyncrasy in the 98th percentile, and Pressey Emotionality in the 10th percentile. The first two of these are practically the reverse of what one should expect.

Case No. 7.—A boy of American parentage, held for burglary. He was of low intelligence, exhibited homosexual tendencies, and was classified as "psychopathic" in a psychiatric examination. He was placed in the 81st percentile on the A-S Test (Landis scoring), 95th percentile in Personality Schedule, and 13th percentile in P.G.R. Frequency. The A-S Test and P.G.R. placements theoretically indicate high emotionality, and the Personality Score indicates low emotionality.

Case No. 19.—An Italian boy who had repeatedly been arrested for theft and burglary. He told the probation officer that the "devil" told him to steal. His record showed him utterly untrustworthy and rapidly developing into an unstable and dangerous character. This boy scored in the 98th percentile on the Almack Test (marked sense of humor), in the 4th percentile on the Pressey Idiosyncrasy (marked nonconformity), and the 15th percentile on P.G.R. Frequency (high frequency).

Case No. 21.—A Polish boy held for theft, truancy, and incorrigibility. He had been repeatedly arrested, and his crimes were of a senseless and dangerous nature. The probation officer considered that the boy was showing signs of an incipient insanity. This boy scored in the 6th percentile on the P.G.R. Frequency (high).

Case No. 42.—A large, overgrown Lithuanian boy, aged 15 years. He had a court record extending over the past 10 years. Part of his trouble was due to an extraordinarily bad home situation and low intelligence, but his record indicated many deviations from normal behavior and showed signs of psychopathy. This boy scored in the 100th percentile on the A-S Test (Landis scoring), the 95th percentile on the Personality Schedule, and the 98th percentile on the Pressey Idiosyncrasy (all supposedly pointing to conformity).

Case No. 71.—A Negro boy, aged 15 years, who was held for theft. The probation officer and the psychiatrist felt that this boy was showing definite psychopathic tendencies. He scored in the 86th percentile on the A-S Test (Landis scoring), the 95th percentile on the Pressey Idiosyncrasy, and the 16th percentile on the Pressey Emotionality Test. The first two of these indicate conformity; the last, non-conformity.

Case No. 78.—A Polish boy, aged 16 years, who was held for theft. His mother was suffering from paranoid dementia praecox and had been confined in an asylum for several years. The father was a habitual drunkard. The boy had a clear record until shortly before we saw him. He suddenly began a career of petty theft, burglary, hold-ups, etc., showing extravagant psychopathic tendencies. This boy was in the 100th percentile on the Personality Schedule, the 89th percentile on the Almack Test, and the 84th on the Pressey Emotionality Test, all indicating conformity.

Case No. 99.—An American boy held for repeatedly running away from home. This boy was an adopted son in an intelligent family. His own intellectual level was not high enough to enable him to fit into the social and intellectual life of the home, so that he came into constant conflict, showing psychopathic behavior. This probably will clear up, since the boy has been removed from this situation. This boy scored in the 83rd percentile on the Almack Test.

Analysis of learning ability based on pursuitmeter records.—In a recent article, Ball (1920) has described "an attempt to make a study of kinaesthetic motor learning among a group of juvenile delinquents through the use of a high relief finger maze." As a result of this experimentation, Ball reported "certain definite characteristics in the learning curve peculiar to those boys of unstable emotional make-up which definitely differentiated them from the others"[1] (meaning, here, those boys of so-called "normal" make-up). This conclusion was reached by the plotting and comparing of the learning curves of both normal and psychopathic cases. The following conclusions which Ball reports in regard to the effect of emotional instability upon the learning process seem of particular importance because of the many and important inferences that might readily be drawn from them: (1) Noticeable differences of performance occur between individuals (carefully selected) of a stable emotional make-up and of an unstable emotional make-up. (2) The reactions of the unstable individuals in learning to image the true path of the maze were of such a nature that obstructions, false leads not previously experienced, etc., caused a very erratic and irregular performance; the maze being practically learned, a new experience of this kind would cause the errors to increase noticeably. (3) Normal, stable, individuals did not allow these obstructions, new experiences, etc., to influence their learning processes to any noticeable extent, as they could adjust themselves to meet the demands of the new situation. (4) The high relief finger maze can be used in most cases as a diagnostic aid in differentiating emotionally stable from emotionally unstable individuals.

It was this fourth conclusion that led us to test Ball's conclusion through the use of another and somewhat similar form of learning, namely, the pursuitmeter. The individual learning curves (errors) for the pursuitmeter performances were plotted, and a composite learning curve, made from the massed data of 50 random cases, was then plotted and smoothed.

With this composite curve as a standard, each of the hundred learning curves were graded subjectively on a four-point A, B, C, D scale, as to the respective amount or degree of variability exhibited when compared to the standard or composite curve. The A group was composed of those curves which showed the greatest amount of conformity to this standard, B the next greatest conformity, etc. Although this grading as A, B, C, or D was, of course, entirely subjective in nature, the curves were graded and regraded by several individuals in order that the scoring, though subjective, might be as accurate and consistent as possible. The results of this grading showed that a great deal of variation was to be found between the different curves, but that this variability in no way corresponded to any of the other criteria of emotionality which were available.

On the evidence furnished by the social histories, the records for the group of 9 boys, constituting the "psychopathic group," were considered separately. Those subjects who definitely had shown abnormal behavior during the administration of tests or during the experimental investigation were designated as "behavior" cases. In order that these two groups might be compared statistically to the "normal" subjects, 25 cases were picked at random from the 100 subjects, and designated as "normal." This last group, of course, did not include any of those subjects who were in either the "psychopathic" or "behavior" groups.

Having so defined the groups, it remained to make statistical comparisons to determine whether there were any significant differences between the learning processes of the three groups. The number of errors made per minute by each subject in each group was computed, and from these the averages and mean variations for each subject were determined. In order to get a comparable measure of variability, the coefficient of relative variability was obtained by dividing the mean variation by the mean in each case. Means of the coefficients of relative variability for each group were next determined. For the "psychopathic" group the mean was found to be .23; for the "behavior" group, .25; and for the "normal" group, .21. Probable errors of the difference between the means of the three groups were obtained.[1] If *A* designates the "normal" group, *B* the "psychopathic," and *C* the "behavior" group, the P.E. difference of *AB* was found to be .021; of *AC*, .024; and of *BC*, .029. The differences of the three groups were, respectively, .02, .04, and .02. Resultant coefficients were .97, 1.67, and .069. This indicates that the above noted differences between means of the three groups are not significant.[1]

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[1] Probable error of the difference = $\sqrt{P.E._{m_1}^2 + P.E._{m_2}^2}$.

The final phase of this part of the analysis consisted in the selection and comparison of the learning curves of the 10 subjects in the highest and the 10 subjects in the lowest deciles of the test scores for the Pressey X-O Test, the Personality Schedule, and the psychogalvanic reflex. This was done in order to determine whether any marked differences in the learning curves of these subjects existed. To facilitate such a comparison, the curves selected were regraded as "rough," "smooth," and "indifferent" (those graphs which most nearly approached the composite curve of massed data from 50 random cases previously plotted, that is, the B and C curves of the previous grading, constituted the group known now as "indifferent"). The results were tabulated as in Table 6. As can be seen by inspection of this tabulation, the differences in the learning curves of those in the highest and those in the lowest deciles are not marked enough to be considered as significant. The columns headed "Theory" contain the numbers which one might expect to obtain if one could apply Ball's high relief maze conclusions to the pursuitmeter.

	Rough Curves		Indifferent Curves		Smooth Curves	
	Actual	Theory	Actual	Theory	Actual	Theory
Pressey X-O:						
Top decile	5	8	2	1	3	1
Bottom decile	3	1	4	1	3	8
Personality Schedule:						
Top decile	3	8	2	1	5	1
Bottom decile	2	1	4	1	4	8
Psychogalvanic reflex:						
Top decile	5	8	1	1	4	1
Bottom decile	4	1	1	1	5	8

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[1] For a difference between means to be significant, it should be at least four times its probable error.

PART II

A STUDY OF 112 DELINQUENT GIRLS

METHOD

SUBJECTS

In the second part of this experiment, a group of 112 girls who had been committed to the Long Lane Farm at Middletown, Connecticut, served as subjects. The age distribution of this group was as follows: 140–49 months, 1 girl; 150–59, 6; 160–69, 6; 170–79, 7; 180–89, 29; 190–99, 26; 200–209, 15; 210–19, 16; 220–28, 6. All of these girls were American-born, but quite a few were first-generation American. On the basis of the nationality of their parents, we may classify them as follows: American-Negro, 11; Italian, 12; Polish, 11; Lithuanian, 6; American (more than two generations), 32; other nationalities or combinations, 40. Eighty-five of these girls had been committed for sexual delinquency, 3 as dependents without support, 13 for theft, 7 as incorrigible, and 4 for running away from home. The group was rather homogeneous in the sense that all of these girls had been subjected to the same environmental conditions from 3 months to 5 years.

TESTS

Personality Schedule.—Thurstone's Personality Schedule (1930) was revised on the basis of his published analysis of results and on the basis of our experience with this test as described in Part I. One hundred and forty-six of his questions were either used as he had used them or reworded so as to be more easily understood by our particular group. We were guided very largely in our selection of these questions by Thurstone's analysis, which indicates the more differentiating questions, and by certain supplementation based on our previous experience with the test.

The H Test.[1]—In Part I, as has been described, we made use of the Almack Test of Humor, which proved unsatisfactory for our purposes. In connection with another research project, which will be reported elsewhere, we devised a new scale of jokes, which we termed the "H Test." In general, we found that this H Test was difficult for these girls, particularly since it had been designed for use with college students. However, the test does seem to have some significance which might profitably be investigated further. It consists of 100 jokes, each of which the subject is asked to consider separately and to rate on the basis of quality. In addition to this quality judgment, the subjects are asked to classify each joke as belonging to some particular category of humor. The definitions of the categories, into which the items were supposed to fit, were printed and given to the subjects for their assistance in making this judgment. The notion back of this procedure is that an individual who feels "superior" may tend to rate many jokes in the "superior" category and to assign high values to these jokes, or that one who is lacking in a sense of proportion might neglect the "quantity" category, etc.

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[1] Further details concerning this test will be found in C. Landis, and J. W. H. Ross, "Humor and its relation to other personality traits," *Jour. Soc. Psychol.*, 1932 (in press).

Introversion and Extroversion Test.—Heidbreder's (1926) revision of Freyd's scale was presented to the subjects in a mimeographed form with the usual directions.

The X-O Test.—I have mentioned in a previous paper (Landis, 1925) that the Pressey X-O Test had as a central theme a valuable idea but that this idea would be more effective if the test was revised. With this point in mind, 500 words, each possessing some affective connotations, were assembled and grouped arbitrarily under the headings of "ailment," "emotion," "dirt," "money," "mentality," "religion," "animals," "self," and "social situations." The subject was directed to go through this vocabulary and to mark out all words which she disliked, disapproved of, or felt referred to anything which was wrong. In order to determine the reliability, the test was given twice to 74 of the girls.

Hull's Test of Suggestibility.—The method of testing waking suggestibility which has been developed recently by Hull (1929*a*) was used with this group. This test is conducted as follows: The subject is blindfolded and told to stand erect. By means of a hook, a thread is attached to the subject's collar and to a recording apparatus. This thread activates a recording pen, so tracing a record of the forward or backward swaying of the subject. The experimenter stands in front of the subject and, having directed her to relax and pay attention only to his words, starts suggestion as follows: "You are swaying forward, more and more forward; you are swaying toward me more and more; etc." This procedure is continued for 1 minute, and then the subject is allowed to stand passively for 1 minute. Many individuals respond positively to this type of suggestion. In order to control the influence of the factor of the sex of the person making the suggestion, this test was performed twice with each subject, so that the suggestion was given once by a man and once by a woman. The temporal order of this last factor was varied so that half of the time the feminine and half of the time the masculine suggestion was first.

The Maze Test.—Following the recent suggestion of Ball (1929), we included in our program the experiment of maze-learning. We made use of Foster's maze "A" (1923). Those blind alleys which led into alternative culs-de-sac were blocked, simplifying both learning and scoring. The subject was shown Foster's maze "B" and allowed to follow through its pattern several times with a stylus so that the general idea of maze-learning was obtained. They were then blindfolded, and the hand which held the stylus was guided through the maze once or twice by the experimenter so that they might have certain kinaesthetic clues as to the correct path. The stylus was then placed at the starting-point, and they were told to find their way to the goal. An entrance into a blind alley or a retracing of the true path of more than 1 inch was counted as one error. Records were made of the time consumed between the start and the goal, and of the total number of errors for each trial. When the subject made three consecutive errorless trials, the maze pattern was considered to be learned. In cases where three such trials were not obtained, the training was discontinued at the end of the twenty-fifth trial. In a few instances we found that the problem was so very difficult for the subject that the training had to be discontinued after some 10 or 12 attempts had been made.

Institution records.—We were able to obtain from the records of the institution the mental age (Stanford revision), educational age (Stanford educational achievement), I.Q.'s, E.Q.'s, A.Q.'s, social and institutional histories.

SCORING METHODS[1]

Personality Schedule (P-S Test).—The Personality Schedule was scored on the basis of the answers which Thurstone had found to indicate emotional or neurotic personality. We reversed the scoring for a few items, since our experience with the Chicago group indicated that the answers given by these younger individuals did not always correspond to those of the college groups. The score on this test is constituted by the number of answers which the subject gives which deviate from the answers given by the so-called "normal" subjects. We also retabulated all answers in this test, as we had done in Part I. This retabulation did not change the scoring of enough items to affect the total scores materially.

The Humor Test (H Test).—In the present analysis, we have considered only the total "H" score. This was arrived at by assigning 11 points to each joke rated as "A," 8 points for "B," 6 points for "C," 3 points for "D," and 1 point for "E." The total of these figures was prorated on the basis of 100 in all cases where the test was not completely filled out.

Introversion-Extroversion Scale (T Test).—All answers of "yes" to the questions in this scale were counted as one each. The total score presumably indicates the amount of introversion of the subject.

The Revised X-O Test.—The score which we have used in the present analysis is constituted by the total number of words which the subject marked out.

Hull's Suggestion Test.—This test was scored as follows: If the subject swayed forward as much as 8–16 cm., she was given a score of +1; if 16 cm. or more, +2. A swaying backward of 6–12 cm. was scored as −1; and of 12 cm. or more, as −2. Swaying between the limits of +1 and −1 was scored as zero.

The Maze Test.—Learning curves for both time and errors were constructed to represent the performance of each subject. These curves were then measured in several ways. We made use of Hull's oscillometer (1929b) to measure the amount of up and down deviations of each time and error curve. By subtracting the measure of downward movement from the measure of upward movement, we obtained a figure representing the slope of each curve. We also went through all the curves, rating each as either "A," "B," "C," or "D." An "A" curve was one which appeared to be relatively smooth; a "D," one which was very jagged; while "B" and "C" were assigned to intermediate steps. The intercorrelation of these five measures, viz., time or error oscillation, time or error slope and subjective rating, showed that all the measures corresponded very closely. For this reason we based most of our computations on the amount of up and down deviation or oscillation in the time curve.

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[1] The summarized data for Part II will be found in Appendix B, pages 321–23

The "r" correlations.—The scores which we obtained on this battery of tests were intercorrelated on the basis of the Pearson

Correlations (Pearson r—Product-Moment Form between Tests Used in Part II

	I.Q.	Humor Score	Personality Score	Introversion T Score	Revised X-O Score
No. of cases	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
I.Q. . .		− .11	− .13	− .10	
Humor score			+ .06	− .04	
Personality score				+ .47	
Introversion T score					
Revised X-O score					
Suggestion . . .					

product-moment formula (*r* correlations) and are given in Table 7. It will be seen, on examination of these figures, that the only correlation of significance is that of +.47 between the P-S and the T tests. This particular correlation is to be expected, since both tests are of the same type and indeed have some items in common. The lack of correlation between all other factors measured is disappointing. From the results which we had obtained in Part I, it seemed possible that a revision of the tests and clarification of method might increase the interrelationship between the factors with which we were dealing. Partial and multiple correlations were derived from these linear correlations; but, as the original figures were low and of little statistical significance, these derived correlations were likewise of no significance.

The η correlations.—As we had found in Part I that certain of our data gave non-linear distributions, it seemed that it would be worth while to apply the method of correlation ratios (η formula) to the newer data. Table 8 gives the tabulated findings obtained by this method. This method gives two correlation values for each relationship, i.e., the value of variable *A* as a means of predicting variable *B*, and, similarly, the value of *B* in the prediction of *A*. "Eta" correlations are subject to three corrections (Kelley, 1923, pp. 240–43), one for attenuation, one for too fine grouping of the data in the process of deriving η, and one for too coarse grouping. The corrections for attenuation and coarse grouping raise the correlation value, while the correction for too fine grouping lowers the correlation markedly. Values given in Table 8 represent the arithmetic mean of the three figures obtained by correcting each correlation. We feel that this mean represents, in

TABLE 8

CORRELATIONS (PEARSON'S η NON-LINEAR FORMULA) BETWEEN TESTS USED IN PART II

The figures represent the values of the ordinate tests predicted from the abscissa tests.

	I.Q.	Humor Score	Personality Score	Introversion T Score	Revised X-O Score	Suggestion	Maze, Time Deviations
No. of cases	112	112	112	112	112	112	112
I.Q.		.18	.20	.24	.28	.36	.33
Humor score	.18		.20	.15	.20	.19	.19
Personality score	.13	.31		.54	.24	.17	.24
Introversion T score	.17	.10	.56		.44	.15	.38
Revised X-O score	.20	.25	.28	.30	. .	.11	.20
Suggestion	.13	.22	.11	.18	.34	. . .	.25
Maze, time deviations	.31	.16	.19	.23	.17	.12	. . . .

all probability, the highest correlation value which exists between the various tests which we used. These 9 figures average 14.5 points higher than the corresponding r's. An examination of the regression lines of the plotted correlation-ratio tabulations showed in every case a curvilinear regression and in many cases a line of a most irregular form.

Any one of these correlation ratios must exceed .30 before it is of statistical significance. The relationship between I.Q. and maze-learning is just over .30, showing the obvious thing, viz., that intellect aids in this learning process. The correlation of .55 between introversion and personality difficulties is likewise obvious, particularly since the two tests had many identical elements. Maze predicted from T Test gives .38 but T Test from maze is .23. We may safely conclude that the relationship is not significant. Tests X-O and T give a relationship of .40. No good reason can be given for this correlation unless it may be that the introvert has a greater number of dislikes than has the extrovert. The point is of interest, and probably further work will clarify it more. None of the other correlations are of significance.

The correlation ratio, according to Kelley (1923, pp. 245-49) represents the approximate upper limit of correlation value which may be obtained from the data. Since the correlations are so low, the conclusion follows that our tests are not measuring variables which have elements in common. Each test represents a measure of some specific and almost entirely independent function. So far, investigation has failed to disclose an underlying and unifying factor, if such a factor does exist.

Bi-serial "r" correlations.—The institution rating scales, together with the summarized case histories, gave dichotomic groupings of our subjects. In order to measure the degree of relationship existing between our test results and these groupings, we made use of the bi-serial r method. The correlations which we worked out are given in Table 9. It will be seen that all these figures are statistically insignificant, with the possible exception of the values of +.30 and −.35 between the introversion (T) scale and "incipient insanity" and "leadership," respectively. These ratios indicate a very slight tendency for introversion to be associated with insanity and with the personality traits of the non-leader. We do not regard these correlations as of particular value, since the dichotomous groupings are very unreliable.

Psychographs.—In order to visualize more clearly the results of the tests, three psychographs were drawn to represent the performance of each subject. One of these showed the total score which the subject made on each test as compared to the average performance of the group on those same tests. The second psychograph analyzed the classes of answers which the subject made

TABLE V

TABULATION OF BI-SERIAL *r* CORRELATIONS

	No. of Cases	Personality Score	Humor Score	Introversion T Score	Revised X-O Score	Mean Total Deviations	Suggestion
No. of cases . . .	.	112	111	112	112	111	111
Incipient insanity . .	11	.13	−.14	.30	.06	.09	−.01
Emotionally unstable	30	.03	−.16	−.01	.24	.13	.02
Very poor heredity .	67	−.03		..	.	.	. ..
Adaptable . . .	74	−.11	.. .	. ..	. . . . . .	. . .	−.17
Stubborn	46	.10	..	.. .		. . . .	.08
Boisterous .	51	. . . .	.04	. .	. . . . .	. . . . . .	. . . .
Leader	78	.	.	−.35		.	..

on the X-O Test, together with the performance on all other tests. The third analyzed the responses on the H Test with respect to the numerical values assigned to the jokes classified in the various categories, together with the performance on all other tests. These psychographs were then grouped according to the general form of the curves. An attempt was made to relate these groupings to the case histories, institution ratings, extreme deviations in any one test, and to the case summaries. In no instance did we find any relationship. In brief, one may say that the tests used did not give results which could be formed into a psychograph of diagnostic value.

Retabulations.—Following the same procedure that has been described in Part I, we retabulated and rescored all of these tests with weighted scores which were based on the deviation value of each answer. By this procedure it seemed possible that we might be able to find differential standards within the group, even though such standards would in all probability have no application to any other group. A great deal of time and effort was spent on this particular retabulation. The results were essentially negative, in that no way was discovered by which we could refashion our scoring so that the results from our tests could be made to agree with the social histories or characterizations which were available for these girls. Neither could we, on the basis of this method, rescore each test so that the general intercorrelation between the tests would be of any more value than that obtained from the original scores.

Marked deviations.—It seemed possible that those individuals who were placed in the upper or lower 25 per cent of the group by any method of scoring of any particular test might show marked deviations in other tests as well, and that these deviations might be related to the social histories or case summaries. Again our results were essentially negative. There was as high a percentage of individuals who were classified as socially normal in the group showing marked test deviation as those classified as psychopathic or emotionally abnormal.

Suggestion.—The method in which this test was conducted has been described above. We were interested in this experiment from several points of view. First, we wished to know whether there was any relationship between suggestibility under these experimental conditions and suggestibility in everyday life. When our records were compared to the character-rating scales which had been prepared by the members of the school staff, no agreement or relationship was found ($r = .08$). Secondly, we were interested in the effect of the sex of the suggestor upon the behavior of the subject. We found that there was very slight advantage in favor of the woman suggestor in obtaining positive reaction. The difference was so slight as to be of little practical significance. The third point in which we were interested was that of the effect of repetition of the experiment. We found that two-thirds of the subjects reacted exactly the same way on the second repetition of the experiment. In only 8 per cent of the cases was there a total disagreement in reaction, that is, 9 cases reacted positively in the first test and negatively in the second test. This investigation is interesting as a test of the procedure itself; but it failed to give any results which shed light on the particular problems to which this study addressed itself.

Case histories.—We were able to obtain from the case histories on file for each of our subjects a court summary of the previous behavior and delinquency of the case, a report of the social investigation, and a record of their behavior and progress while in the institution. The history also included a periodical rating of character traits which were made by the matrons who had the girls directly under their care. In addition to this, the institution authorities went over the records with us and gave their opinion on each case with respect to the emotional stability, psychopathy, mental deficiency, social causation, etc.

From these data, we were able to relate the results of each test to the character traits which it purported to measure, and to relate the test to the general categories of psychopathy, feeblemindedness, or social maladjustment. This comparison was very carefully worked up, since it seemed possible that, by subdividing our tests, their relationship to the more finely divided character traits might indicate information of value. Unfortunately, we were unable to make any one of the tests or parts of the tests agree with the character ratings or with the general summaries. This same procedure was attempted with the massed results of the testing program, that is to say, we derived a group score for each individual, based on the combined score of the individual tests, and compared this score with the case history records. Again no essential relationship was found.

It seems only fair to conclude that either the tests which we used did not bear any essential correspondence to the character traits as they were formulated by the institution authorities or that the character traits had not afforded well-defined entities which are open for experimental classification.

DISCUSSION OF PARTS I AND II

In order that the findings from both Parts I and II may be related and compared, we will take up in this discussion the general results of the entire study and attempt to relate these data, both positive and negative, to the present-day status of the general problems of emotion and psychopathy.

The theory that the psychogalvanic reflex is a function under control of the autonomic nervous system and, hence, somehow connected with emotion rests on the following evidence. It has been shown by several investigators (Richter, 1927) that the appearance of the reflex depends upon the integrity of the motor autonomic (sympathetic) fibers of the skin. It has also been demonstrated that injury of certain thalamic centers of autonomic control in the mid-brain lead to disturbances of this reflex (Foa and Peserico, 1923; Wang, Pan, and Lu, 1929). Following the work of the physiologists (Cannon, 1929, pp. 20–36), we are accustomed to state that the autonomic nervous system is divided into three major segments and that the activity of these segments is of a balanced nature. Hence, since this reflex has been shown to be under the control of the sympathetic division, one might legitimately expect to find that the appearance of this phenomenon indicated changes in autonomic balance and function. The theory is also current in present-day psychology (Bard, 1929) that emotion is somehow a function of the autonomic nervous system. Either the emotion is controlled by this system or emotion involves extraordinary or peculiar reactions mediated over this system.

Our study fails to lend support to this line of argument. We failed to find that the reflex invariably or solely accompanied the objectively observed signs of emotional disturbance, correlated with tests of emotionality, or bore any definite relationship to the personality of the individual, so far as that personality might be judged from records of his previous behavior. We failed to find any unequivocal evidence of a correlation between this reflex and segmental autonomic activity. We failed to find any evidence which would lead one to believe that reactions mediated over the autonomic nervous system were essential to emotion, *if* this electrical response is strictly an autonomic function.

This point is of more than theoretical importance. On the basis of introspection we are led to believe that emotion is somehow a unique experience usually involving pronounced visceral changes. In previous studies (Landis, 1929) we failed to find that visceral changes bear any one-to-one relationship to the name given to the experienced emotion. Here we fail to find positive evidence that the autonomic nervous system has any direct relationship to emotion as judged by general behavior. It is true that our method of testing does not cover all of the possibilities. It may also be argued that the method is not a valid one of showing autonomic function.

However, the evidence on which we have based our argument is as clear cut and exact as the evidence on which has been based the theory that emotion is somehow a function dependent on the autonomic nervous system. Certain comments may be made which may aid in clearing up some of these difficulties. First, we do not believe that there is any evidence which would indicate that the psychogalvanic reflex bears any necessary one-to-one relationship to any of the classical psychological categories (Landis, 1930). Secondly, the evidence is far from clear that the autonomic nervous system acts in a segmental fashion so far as the sympathetic innervation of the skin is concerned. Lastly, there is no reason to believe, at present, that any relationship necessarily exists between emotion, in all of the diverse meanings of the term, and the autonomic nervous system.

What, then, is the place of the psychogalvanic reflex in a personality study? This phenomenon has the same relationship to the total behavior of an individual that blood pressure, respiration, or changes in skin color have. That is, any of these physiological changes may occur together with one or another of the psychological categories such as emotion or attention. We may have a blood pressure change accompanying shock or surprise. The same change may occur when the subject is quiet and reports no distinctive alteration in his mental life. These changes are physiological in nature, and may, or may not, accompany events which are given psychological names. The same is true for these electrical responses. They may, and frequently do, appear in surprise, in efforts of will (conation), with flights of imagination, with certain varieties of ideation, or as evidence of a physiological readjustment within the body, which has no psychological concomitant of which the subject is aware. The argument that the psychogalvanic reflex is specific to emotion is true only in case one wishes to define emotion as "that which accompanies the psychogalvanic reflex." In accepting such a definition, one would have to recognize "unconscious emotion" and the appearance or involvement of emotion during other forms of psychological activity which the subject was not willing to call "emotion." There seems to be no reason to include the psychogalvanic reflex in a personality study unless this test is used for purposes of investigating certain underlying physiological mechanisms which are probably related to the control of skin temperature.

The use of the pursuitmeter in an experiment such as this was in the nature of an attempt to provide a situation which might result in exasperation or other mild emotional reactions on the part of a subject, and still be within the limits of permissible experimentation with subjects who neither consented nor co-operated freely. These boys showed differences in their ability to operate this apparatus continuously and successfully. The apparatus is a good one with which to test steadiness, co-ordination, and possibly learning. The experiment provided no basis for the belief that learning, steadiness, or eye-hand co-ordination correlated more than slightly with any other of the test measures with which we dealt. As a device to bring on exasperation or emotional reactions in a subject, we found this instrument fairly successful. A majority of our subjects exhibited no emotional reactions; but a small number of them were definitely exasperated, angry, grief-stricken, etc.

Thurstone's personality schedule, as we have stated, was developed for use with college students. The question of whether or not this type of questionnaire may be developed or modified for use with groups of juvenile delinquents is pertinent. From many points of view such a development seems almost impossible. These juvenile groups are too diverse and changeable in training, interests, education, and environment to afford test results which will be either reliable or valid. The very fact that these children are called "delinquents" implies a social concept which has no psychological relevancy. The fact of delinquency means only that the individual violated some social regulation and has been *caught and incarcerated* as a result of the violation. The background and system upon which the selection of such a group is based is one which involves a consideration of the entire question of criminology. In view of this, it is our opinion that the personality schedule can be used only as a sign post and cannot serve as a measuring rod. We see no reason to believe that it can do more than indicate tendencies which certain individuals may possess without affording any relative measure of these tendencies. The total test score which an individual obtains represents, then, that individual's performance with respect to the group of which he is a member. High scores or low scores can only be interpreted with reference to the entire group. The test is of more value when each item of the schedule is considered as a leading question and is used for further sociological or psychological investigations in the experimental field. The method is useful in that it should suggest experiments to meet the problems of each individual case, but it does not lend itself to measurement in the same sense that an intelligence test is considered to be a measuring device.

In Part I of this study we found that the Pressey X-O test had little practical value as a diagnostic basis of psychopathic behavior. This, we felt, was due to the fact that the standards for the test had been obtained from a group of normal school children who had not come into open conflict with the police power of society. The most valuable information to be gained from the test was the measure of the number of likes and dislikes of the subject. With this in mind the test was revised as has been described in Part II. The revised X-O created a longer and more comprehensive list of words which might be expected to have unpleasant affective associations for certain individuals. The idea back of this test seemed to be a good one, and we hoped to obtain significant results. It seemed reasonable to suppose that an individual who was psychopathic or emotionally unstable would have a much greater range of dislikes than one who was well adjusted socially. However, our revised X-O gave disappointing results. The reason for this failure is not obvious. It is not to be explained by the influence of age, intelligence, co-operation, or factors of this variety, since this test does not correlate with any of these measures. We are really at a loss to explain the lack of correlation between this test and any of our other standards or tests. This revised X-O test had a reliability of .72. (This figure was obtained by retesting 74 of the subjects after an interval of 2 weeks.) The test is at least as valid as any other test of emotionality which we employed. One can only suggest that perhaps the Pressey X-O gave correlations in its original form because of its similarity to other tests and not because of the essential idea back of the test.

As we have emphasized before, there is every reason to believe that the analysis and measurement of humor should enter into every personality study. Theoretically, the sense of humor (whatever that may mean) enters into all personality judgments and character estimates. If this is true, there should be some way in which one might approximate a relative measure of the amount or kind of humor which any individual possesses. The difficulties in constructing a test of humor are pronounced but probably not insurmountable. It should be possible to assemble a collection of jokes, humorous illustrations, puns, anecdotes, etc., which would offer a fair sample of what passes for humor in the world in general. The selection of these items and the evaluation of the answers or ratings which any individual might place on the items is only a matter of continued experimentation and refinement. The test, as we used it, represented only a second step in this process of refinement. It seems altogether possible and plausible that further investigation and experimentation of this variety would give a test which would be of real value in the appraisal of personality.

The study reported by Landis, Gullette, and Jacobsen (1925) and the present investigation have made use of most of the many "tests" of emotionality. Expressiveness, experimental stability, amount of laughter, rating scales of emotionality and stability, the Woodworth Questionnaire, the Pressey X-O Test, range and variability of blood pressure, reaction time, speed of tapping, a vocabulary test, height-weight ratio, fatigue indexes, humor tests, Ascendancy-Submission Test, Personality Schedules, frequency and latency of the psychogalvanic reflex, performance on the pursuitmeter, and amount of movement on the stabilometer—all have been employed in these experiments and all have shown but little interrelationship. We believe that the essential difficulty in the personality test program at present lies in the fact that we, as well as other investigators, have been attempting to test very, very complicated varieties of human behavior, which have little in common except the name "emotion." Each test probably measures an independent variable which is but slightly, if at all, related to the other factors with which we have been concerned.

Is there such a thing as "general emotionality" or are these only specific emotional patterns? Spearman (1928) has attempted to make a case for the possibility of a general factor of emotionality in the same sense that he has done with the "G" factor of intelligence. It is also common sense to say that one individual exhibits a higher general emotionality than another. The analysis which we have employed in this study, as well as that in our previous studies of emotional reactions, lends no support to the concept of "general emotionality." Our experiments show that "general emotionality" as a personality or character trait is either a social concept or an abstraction. Just as "poetry" stands for a variety of literary composition, so "emotion" may stand for the entire realm of affective experiences. However, "poetry" is in no sense descriptive of any particular composition nor does it necessarily tell us anything concerning the form, content, ideas, measures, or value, of the composition with which we are dealing. Such terms are then abstractions or categories which are linguistically and socially valuable but are of doubtful value scientifically.

The same criticisms and evaluations which we have applied to the term "emotionality" apply also to "psychopathy." This word has a varied and indefinite significance which clinicians and social workers find valuable in the absence of a better term. However, as the problem stands at present, the term lacks a satisfactory definition and defies experimental verification. It seems to be made up of a vast variety of only very slightly related factors which vary independently and whose algebraic sum gives what is clinically spoken of as the "degree of psychopathy." The term does not lend itself to psychological experimentation; and, before further scientific progress can be made, it is necessary that the problem be reformulated or that new methods of investigation become available.

None of these general abstractions has as yet lent itself to scientific psychological analysis. In order to proceed scientifically, it will be necessary that the boundaries and descriptions of the particular factors with which we are dealing be redefined. As this exactitude becomes more prevalent, the real analysis and experimental verification of behavior will attain an increasing degree of statistical reliability and validity. It is equally obvious that there is an urgent need for new methods to be used in the investigation of these problems.

Today the question of the possibility of defining these personality traits and categories is urgent and pressing. The question of the possibility of using either new terms or defining the old terms, so as to omit the material which the investigator feels is irrelevant, is undecided. The implication that the categories must be split into many separate and discrete functions which are actually measurable may, or may not, be justifiable. This process of splitting has been attempted after a fashion in this study. The factors which we attempted to measure were rather more carefully outlined than was the general term "personality," or "emotionality." However, it is obvious that our definitions were not exact enough, nor was our splitting of the problem fine enough, to show the basic individual functions. Whether a further analytical refinement would lead to significant results is an open question. The problem of the measurement of personality traits is urgent, psychologically, sociologically, and economically; but its urgency does not mean that an answer will be quickly or easily found. From the analytical viewpoint, it is possible only to continue with the general method and change it as circumstances arise, indicating such variations. The future of the problem of personality analysis and measurement is not clear. The desirability of a synthetic rather than an analytic approach may be considered. The concepts which are being advanced by the Gestalt psychologists may change our entire viewpoint so that the analytical method will cease to be as dominating as it has been in the past. At present, the Gestalt hypothesis is not clearly enough established to allow an immediate reformulation of the problem.

It is further possible that the present-day attempt to make a psychological analysis of social problems will be shown to be truly impossible with our present methods of investigation, and that only a sociological analysis based on entirely different methods may be employed. That is, as social psychology advances, it should devise and bring out methods which are of particular value in the solution of the problems posed by this study. Certain it is that the psychological methods now at hand are not suitable or readily adaptable to the problems which we attempted to solve in this study.

CONCLUSIONS

1. *Neither age, race, nor social offense is related in constant fashion to either emotional stability or to the tests which we have employed in this investigation.* One might guess that the age factor in personality development should modify the performance on some one of our battery of tests. It is also reasonable to suppose that children who are first-generation Americans would have more difficulty in adjusting to American life than children born in American homes of several generations standing. It also seems reasonable to believe that the type of social offense for which an individual has been imprisoned is frequently an index of the personality of that individual. Unfortunately, we have been unable to find any of these relationships in our testing program. This does not mean that the suppositions are wholly incorrect, but it does indicate that the tests which have been employed were not adapted to bring out these relationships (if they do exist) which, we might suppose, are well enough marked to influence any testing program.

2. *The degree of intellectual capacity (I.Q.) bears no relationship to emotional factors which are involved in delinquency.* It is, of course, a well-known fact that our corrective institutions are crowded with individuals of a low mental caliber and that they contain only a small percentage of individuals of high mental ability. One might expect to find that this low intellectual ability would be in some way connected with an emotional inadequacy or instability. If this is true, then our tests were inadequate to establish the fact, since we were unable to obtain evidence of relationship between measures of intellectual ability and measures of emotionality.

3. *Thurstone's Personality Schedule, which has been shown to be of value with a college population, fails to give diagnostic results when revised for use with juvenile delinquents.* Several factors were probably operating to bring about this result. In the first place, the groups of juvenile delinquents upon which this study is based

were probably much less homogeneous than the college groups. These delinquents are held by the law for such a wide variety of causes as to result in a heterogeneity of population. Such a diversification may explain the inadequacy of the Schedule in our testing program. A second factor which influences our results depends on the fact that personality components of the delinquents are more diverse than they are in a college group. The college group is held together by common purposes and by common sorts of interests. No such purposes or interests can be established in a delinquent group; hence the deviations which give satisfactory diagnostic signs in a college group have no particular meaning or significance when applied to the problems of delinquency, since these delinquents are more diversified to start with.

4. *Heidbreder's Temperament (Introversion-Extroversion) Test, although valid and reliable with college groups, is of much less value with juvenile delinquents.* The same factors which influence the results of the Personality Schedule affect the results of this Temperament Scale. This is, in part, indicated by the correlation which has been shown to exist between the Temperament Scale and the Personality Schedule. Introversion, as such, probably plays some rôle in juvenile delinquency, but its effect is a minor one.

5. *Our revision of the text and of the scoring of Allport's Ascendancy-Submission Test was not successful as a method of measuring character traits in juvenile delinquents.* It seems quite probable that the traits of ascendancy or submission, *per se*, do not influence juvenile delinquents in any fixed fashion. The effect of social pressure upon these individuals is so varied that the test is inadequate in this capacity. It is peculiar that we found a total lack of correlation between our revision of Allport's Test and the Personality Schedule. These two tests have many elements in common, so that one should expect a positive correlation of respectable size, especially since such a relationship was found between the Personality Schedule and the Temperament Test. Evidently, Allport's Test deals with some independent function which, despite the common method of the testing, is not itself related to other personality traits.

6. *Tests of the appreciation of humor do not yield satisfactory results with the group on which this study was conducted.* We have criticized the make-up of the Almack Test. The factor of humor, as it was tested by our H Test, is evidently an independent variable which is related in no constant fashion to other personality traits as we measured them.

7. *The Pressey X-O Test, neither in its original nor in our revised form, gave results of practical diagnostic value.* Various investigators who have applied this X-O Test to groups of school children have reported that the test was of diagnostic value. This finding we did not substantiate with juvenile delinquents. Whether our negative results are due to the lack of temperamental homogeneity in our groups, or whether the lower intellectual ability of these delinquent groups made it impossible to obtain fair scores on the X-O Test, is impossible to say.

In addition, it should be pointed out that one of the essential ideas of this test, namely, the crossing-out of words which have an affective value, has been regarded as an idea of particular merit (Landis, Gullette, and Jacobsen, 1925). When we attempted to test out this idea by assembling a longer list of such words and changing the form of presentation slightly, we found that the test did not work at all. No satisfactory explanation can be given for this finding.

8. *That the type of learning curve obtained in learning a maze offers an objective test of emotional stability, as claimed by Ball, we were unable to confirm.* It is probably true that the immediate reactions of the subject, while he is learning the maze, give one some notion concerning the immediate emotional stability of the subject. However, there is not the slightest reason to believe that this immediate performance has any very close relationship to the general emotionality or emotional stability of any individual, or indeed to the form of the learning curve. The immediate emotional expressions depend upon the mutual effect of the social situation and the physiological condition of the individual at the time at which the test is conducted. This may, or may not, have relationship to a general factor of emotion (if such a general factor exists). The results which were obtained with the pursuitmeter

and stabilometer might have been expected to show something of the sort which Ball claimed for the maze performance. However, these tests were no more satisfactory than any other which we employed.

9. *Hull's test of waking suggestion gave clear differentiation between individuals, but this difference bore no relationship to other tests or ratings of character traits.* Again, we can only conclude that this procedure measures some independent variable or function whose psychological significance (if any) is unknown. Whether suggestibility, as indicated by this test, has any relationship to general suggestibility in the social conditions of everyday life is an open question for which our data afford no answer.

10. *The frequency of the appearance of the psychogalvanic reflex, or the comparative delay in its appearance, in exasperating situations bears no relation to any other measure or rating of emotionality.* This point has been developed at length in a previous article (Landis, 1930). As was shown at that time, there is no real evidence to indicate that this reflex has any necessary relationship to emotion. I am quite aware of the fact that the belief is prevalent in psychology today that the psychogalvanic reflex is an indicator of emotion. However, this present study and other studies reported previously all show the inadequacy of the theory. The significance of the possible relationship between these reflexes, the autonomic nervous system, and emotion have been discussed above.

11. *Case histories, although of undoubted practical value, do not readily lend themselves to the purposes of close scientific analysis.* There is a real need of a scaling method in case history work which will be of value in scientific analysis.

12. *Various statistical procedures designed to show the correlations existing between the functions tested in this study gave negative results.* Several explanations might be advanced to explain this. It is possible that each test employed measured some independent function which had little or no overlapping with the other functions so measured. It is also possible that there is no common factor which unites or organizes these independent functions. That general emotionality exists as a physiological or psychological

entity is a dubious proposition. Certainly, we have no objective criterion of this supposed function nor have we any reliable or valid measure of its existence.

13. *An analysis of the individual test performances with respect to the conformity or nonconformity of each subject, as compared to the entire group, shows that conformity with respect to these tests does not agree with conformity in general life-situations.* We have discussed in this paper the notion that psychopathy might be defined essentially as nonconformity to group standards. If this is true, then one should expect to find that those individuals whose record of past behavior is marked by "psychopathy" would show marked deviations from the average performance of the group. This fact should be one which would be easily and clearly established. Our tests failed completely to bring out any such deviations. It is possible that psychopathy and nonconformity of behavior are to be identified, but certainly this testing program gave no substantiation to the theory.

14. *In general, it may be concluded that analytical investigations of the personality traits of emotionality or psychopathy are unsatisfactory and fail to bring out decisive evidence.* The present experimental test methods are not adapted to answer either positively or negatively the questions concerning personality traits. Such answers must await the development of new methodological approaches.

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SYMBOLS AND ABBREVIATIONS USED IN APPENDIX

Nationality: Amer. N., American Negro; Amer., American; Aus., Austrian; Cz., Czech or Bohemian; Eng., English; Fr. Can., French Canadian; Fr., French; Ger., German; Hung., Hungarian; Ital., Italian; Lith., Lithuanian; Norw., Norwegian; Pol., Polish; Rus., Russian; Other or Mix., parents of different nationalities.

Held for or committed for: Mis., misdemeanor; Tru., truancy; R.A.H., ran away from home; Incor., incorrigible; S.D., sex delinquency; Dep., dependent.

Classification: P., psychopathic (incipient insanity, pronounced emotional instability, behavior difficulties); S., social (poor family, bad associates, etc.).

APPENDIX A

No.	Nationality	Held For	Age (Year and Month)	"I.Q."	Voltage	Total Number of P.G.R.'s	Personality Schedule	Primary Knowledge	Primary Morality (Group Score)	A-S Test (Landis Score)	A-S Test (Allport Score)	Sense of Humor (Almack Score)	Sense of Humor ([illegible] Score)	Pursuit-meter (Errors per Minute)	Stabilimeter (Movements per Minute)
1	Amer. N.	Mis.	15-10	72	9	25	48	90	58	82	−10	100	225	24.3	2.00
2	Lith.	Tru.	14-0	88	9	53	19	83	38	26	−32	88	265	38.5	2.13
3	Ger.	Theft	16-4	81	9	28	22	123	42	22	−17	84	285	33.2	0.50
4	Ger.	Dep.	17-11	96	9	56	44	163	38	28	− 1	106	173	38.1	4.55
5	Amer.	Incor.	15-5	91	4½	14	18	63	35	45	25	91	291	39.7	2.25
6	Amer.	R.A.H.	14-0	82	9	100	28	270	36	25	11	94	297	31.0	2.48
7	Mix.	Theft	17-11	70	9	4	47			35	− 9	84	278	30.6	3.80
8	Amer.	Tru.	15-9	70	9	20	12	168	31	28	− 6	110	285	33.3	2.10
9	Pol.	Theft	15-1	74	9	17	20	174	32	35	0	63	131	38.2	3.00
10	Ital.	R.A.H.	10-8	79	9	78	39			26	−25	80	211	30.7	2.15
11	Pol.	R.A.H.	15-8	102	9	4	25	86	34	22	−35	133	185	36.6	1.20
12	Pol.	Theft	16-9	81	9	0	19	95	31	78	−21	80	209	38.2	0.30
13	Amer. N.	Theft	16-10	75	9	7	18	133	32	10	−15	103	203	39.4	0.90
14	Amer. N.	Mis.	15-10	80	6	40	24	150	31	38	−23	128	200	44.4	1.10
15	Lith.	Tru.	14-2	92	9	36	22	137	36	17	− 8	116	258	24.1	0.35
16	Rus.	R.A.H.	18-3	70	3½	29	29	297	30	17	−35	98	294	43.7	1.85
17	Amer.	R.A.H.	14-7	100	9	6	40	360	25	41	−12	91	290	46.4	1.73
18	Amer.	Incor.	16-6	100	9	9	30	153	37	25	16	90	308	31.5	0.48
19	Ital.	Theft	14-3	80	9	6	24	118	18	31	− 4	102	306	31.5	0.43
20	Amer.	Theft	15-0	84	3	15	18	112	38	32	−15	101	188	27.8	6.33
21	Pol.	R.A.H.	16-1	75	4½	3	38			18	−10	90	203	26.5	3.00
22	Amer.	Theft	18-4	88	9	34	34	188	31	28	1	91	324	18.4	0.35
23	Amer.	Incor.	10-11	80	9	90	37			36	−18	91	170	24.8	0.63
24	Ital.	Theft	14-6	85	9	27	18			23	−22	105	248	20.8	0.94
25	Ital.	Theft	11-6	84	2½	8	65			20	4	121	233	26.3	3.02
26	Amer.	Tru.	13-8	95	9	26	15	82	33	22	−12	100	258	25.4	1.32
27	Pol.	Theft	10-7	85	8	27	12	175	35	29	− 5	104	276	37.4	1.20
28	Ger.	Theft	15-0	80	0	28	50	80	34	33	−23	101	295	16.2	2.25
29	Amer.	R.A.H.	10-2	100	8	7	41	134	36	17	21	110	303	26.2	3.78
30	Ital.	Theft	14-2	80	9	37	51			15	−21	84	258	30.5	5.87
31	Mix.	Theft	13-10	82	9	2	42			12	−33	87	289	19.1	0.12
32	Ger.	Mis.	13-6	87	9	2	10			20	−35	90	301	55.3	2.37
33	Ger.	Tru.	14-3	82	9	20	15	157	37	28	2	97	307	73.7	1.55
34	Amer.	Tru.	14-6	80	6	15	43	274	42	31	−11	87	281	17.8	0.80

	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Stabilometer (Movements per Minute)
35	Pol.	Theft	64	19	19	360	30	[illegible]	104	270	28.	00
36	Ger.	Incor.	86	28	35	144	31	23	110	278	23.	11
37	Pol.	Theft	96	4	36	160	37	14	105	261	30	58
38	Pol.	Theft	70	30	22	118	36	28	73	207	25	00
39	Amer.	Theft	77	57	26	187	34	23	96	284	30.	10
40	Amer.	Theft	94	30	30			33	80	287	27.	73
41	Aus.	R.A.I	86	45	46	390	18	30	73	278	48	.23
42	Lith.	Theft	71	28	55	245	17	60	72	286	37	.56
43	Pol.	Theft	75	32	51	240	44	34	74	268	38	.16
44	Pol.	Theft	88	71	25	237	42	25	110	305	37	.20
45	Aus.	Theft	94	2	49	132		24	92	249	26.	.40
46	Ger.	R.A.I	98	100	13			7	130	267	39.	.43
47	Cz.	Theft	86	22	32	84		20	90	267	45	.90
48	Pol.	Theft	83	12	36	158		12	88	205	29.	.40
49	Pol.	Theft	90	14	40			33	76	255	28.	.90
50	Ital.	Theft	100	54	37	64		18	93	264	36	.30
51	Amer.	Tru.	95	10	24	153		29	93	291	36.	.00
52	Pol.	Mis.	95	113	42	160		14	96	303	30	.20
53	Ital.	R.A.I	70	15	47			27	88	290	33.	.25
54	Pol.	Theft	75	46	40	163		37	118	200	38.	.82
55	Lith.	R.A.I	72	129	34	197		32	93	244	30	.05
56	Amer.	R.A.I	90	13	15	73		21	92	270	19.	.52
57	Amer.	Tru.	85	3	22	116		45	98	296	33.	.00
58	Pol.	Incor	78	4	40			20	88	227	24.	.16
59	Pol.	Incor	82	23	34			32	94	253	37.	.00
60	Ital.	Incor	94	60	35			23	95	210	40	.84
61	Pol.	Theft	90	63	39	194		35	174	260	33	.37
62	Pol.	R.A.I	88	103	13	98		17	125	281	30.	.75
63	Ital.	Theft	74	13	46	264		30	96	293	30	.06
64	Pol.	Incor	92	31	19	137		19	118	254	30.	.62
65	Mix.	R.A.I	85	3	26	.....		30	100	286	32	.12
66	Amer.	Theft	75	7	14	.....		10	81	273	41.	.10
67	Pol.	Theft	78	4	13	154		11	113	293	40	.10

APPENDIX A—*Continued*

			Age (Year and Month)		Total Number of G.R.'s	Personality Schedule	[illegible]		A-S Test (Leads Score)	A-S Test (Allport Score)				[illegible] (Movements per Minute)
68	Rus.	Mis.	15-5	80	10	35		43	36		92	300		.88
69	Pol.	Mis.	14-5	85	36	22		37	11		100	299		.60
70	Pol.	Theft	13-1	64	39	09		.	45		96	120		.50
71	Amer.	Theft	14-9	72	16	39	92	42	37		80	182		.29
72	Amer.	Theft	14-10	80	4	24	70	33	48		94	306	30.	.60
73	Pol.	Mis.	16-1	100	47	48	13	35	22		112	250	12.	.05
74	Pol.	R.A.H.	13-11	92	4	36	. .	. .	30		95	280	37.	55
75	Amer.	Theft	17-0	85	15	30	54	42	21		98	277	31	.19
76	Amer.	Theft	16-10	75	40	35	50	48	50		117	264	36	.39
77	Amer.	R.A.H.	10-4	80	25	33	167	34	40		86	298	23	.80
78	Pol.	Theft	15-11	87	10	70	156	37	18		88	200	20.	.50
79	Lith.	Tru.	11-7		7	72	.		41		89	280	28	.50
80	Lith.	R.A.H.	15-0		1	40	36		11		105	283	41	.25
81	Aus.	Theft	13-9		25	36			33		98	297	31	.08
82	Mix.	Mis.	12-4		98	36	72		38		92	256	36	01
83	Amer. N.	Theft	13-3		11	50	.	. .	28		82	270	32	.00
84	Aus.	Theft	14-1		72	36	54	32	30		87	311	31	.32
85	Pol.	Theft	10-2		81	15	23	32	13		104	267	36.	75
86	Amer. N.	Theft	14-0	92		33	174	50	16		102	284	33	.42
87	Amer. N.	Mis.	10-9	80		30		. .	23		95	278	21	.00
88	Lith.	Theft	15-3	85		30	155	42	42		107	298	31.	37
89	Ger.	R.A.H.	10-0	78		27	31	34	22		90	280	42	.15
90	Amer. N.	Theft	13-0	60		40		.	25		84	207	31.	.75
91	Amer. N.	Theft	13-10	58	11	16	22	47	24		77	281	32.	05
92	Amer.	Theft	15-0	82	17	19	72	30	30		102	280	42	15
93	Lith.	Theft	15-3	09	7	25	05	33	13		97	303	47	75
94	Amer.	Mis.	10-11	115	44	25	65	45	30		157	257	28.	60
95	Amer.	Theft	14-1	98	12	35	144	40	33		103	273	25.	40
96	Amer.	Theft	15-0	100	45	30	61	32	20		100	276	23.	.30
97	Amer.	Theft	16-5	85	41	30	05	30	34		84	281	20.	00
98	Pol.	Tru.	15-4	90	13	20	34	37	30		102	275	54.	75
99	Amer.	R.A.H.	10-7	95	30	20	44	36	33		120	290	23.	00
100	Pol.	Theft	16-8	75	16	24			—		157	255	—	

APPENDIX B

Case No.	Nationality	Committed For—	Age (Years and Months)	Classification	E.Q.	I.Q.	Binet Score	T Score	P.S Score	X.O Score	Suggestion	Mass
1	Mix.	S.D.	18.8	P	83	100	8.4	27	18	274	6	C
2	Amer.	Theft	17.2	S	83	73	6.7	22	44	311	6	D
3	Amer.	Dep.	16.11	P	81	82	9.4	35	74	84	9	D
4	Pol.	S.D.	17.11	S	77	76	9.6	25	29	171	7	B
5	Ital.	S.D.	16.1	S	83	79	7.5	30	37	278	6	C
6	Mix.	R.A.H.	15.6	P	118	117	5.5	30	66	134	6	A
7	Amer.	S.D.	14.11	S	95	85	2.2	28	14	280	6	B
8	Amer.	S.D.	15.4	S	98	95	7.7	31	68	254	10	A
9	Amer.	R.A.H.	14.6	S	71	68	6.1	24	65	145	6	D
10	Amer.	R.A.H.	15.2	P	71	76	7.3	23	53	238	7	E
11	Amer. N.	Incor.	15.5	S	70	74	5.4	17	27	145	6	C
12	Amer.	Theft	13.0	S	69	97	9.0	15	39	88	10	E
13	Ital.	S.D.	15.10	S	96	89	6.2	25	50	114	5	B
14	Lith.	S.D.	14.0	P	84	89	6.9	29	57	234	10	C
15	Mix.	S.D.	14.11	S	90	103	7.8	23	43	234	10	C
16	Mix.	S.D.	16.2	P	92	92	5.6	26	52	247	10	B
17	Ital.	S.D.	14.2	S	95	101	4.4	26	32	99	10	A
18	Amer.	S.D.	15.1	S	97	100	7.2	21	29	113	5	E
19	Amer.	S.D.	17.8	S	86	91	7.5	20	21	230	5	D
20	Mix.	Theft	14.10	P	94	89	4.0	24	23	291	4	B
21	Amer.	R.A.H.	17.9	P	76	76	7.7	20	75	296	6	D
22	Lith.	S.D.	17.6	S	68	74	4.3	18	45	413	8	D
23	Amer.	S.D.	15.2	S	89	80	7.8	20	35	441	6	C
24	Pol.	S.D.	17.11	S	85	93	7.9	23	55	290	7	C
25	Lith.	S.D.	17.11	S	79	78	7.0	19	68	133	6	A
26	Amer.	S.D.	16.1	S	83	84	5.9	25	43	266	6	C
27	Amer.	Theft	14.1	P	93	95	5.1	20	37	250	5	B
28	Eng.	Incor.	16.5	P	93	94	6.5	22	28	347	6	B
29	Mix.	S.D.	17.9	S	91	82	10.4	18	23	7	6	C
30	Mix.	Theft	13.7	P	84	79	6.6	24	30	410	4	C
31	Cz.	S.D.	15.8	P	76	71	4.1	22	47	238	5	C
32	Aus.	Theft	13.10	S	104	89	9.4	20	21	196	7	D
33	Amer.	S.D.	17.3	S	78	75	7.7	30	59	244	6	C
34	Amer. N.	S.D.	16.5	S	77	70	7.7	28	31	93	6	C
35	Amer. N.	Dep.	16.5	P	70	70	5.7	21	45	413	6	D
36	Amer.	S.D.	16.11	S	95	90	6.2	27	69	309	6	C
37	Fr.	S.D.	15.9	P	78	64	5.9	25	43	162	10	E
38	Fr.	S.D.	18.10	S	73	73	2.0	23	33	125	6	D
39	Amer.	S.D.	17.0	P	80	81	8.0	17	20	75	4	E
40	Amer.	S.D.	15.5	S	89	87	6.0	30	78	307	6	A
41	Pol.	Theft	13.9	P	75	93	7.4	27	35	225	9	E
42	Cz.	S.D.	16.9	S	73	73	8.0	25	51	187	10	B
43	Pol.	S.D.	15.10	S	84	74	7.0	29	58	232	8	C
44	Mix.	S.D.	17.9	P	60	62	6.4	19	47	5	5	E
45	Mix.	S.D.	16.7	S	70	90	6.0	9	50	104	7	A
46	Mix.	S.D.	13.1	S	90	94	6.8	22	60	164	4	D
47	Pol.	S.D.	14.2	S	85	91	5.5	24	45	323	7	B
48	Amer.	S.D.	10.7	S	78	80	6.5	17	48	173	6	C

APPENDIX B—*Continued*

Case No.	Nationality	Committed For—	Age (Years and Months)	Classification	E.Q.	I.Q.	Healy Score	T Score	P-S Score	Kohs Score	Suggestion	Maze
49	Amer.	S.D.	17-11	P	73	65	7 3	31	40	120	10	C
50	Pol.	S.D.	14 9	S	95	79	6 7	16	35	142	6	C
51	Fr. Can.	S.D.	16 4	P	71	70	8 7	28	59	263	6	H
52	Fr. Can.	S.D.	18 9	S	68	70	5 9	32	75	247	4	H
53	Ital.	S.D.	18.1	S	77	80	6 3	16	43	410	6	C
54	Amer.	Theft	15 7	S	82	86	5 9	28	42	104	6	H
55	Amer.	S.D.	18 3	P	80	98	7 4	15	30	305	7	E
56	Ital.	S.D.	17.7	S	73	84	7 6	24	68	166	6	E
57	Ital.	S.D.	11 9	P	106	108	6 8	30	60	213	6	D
58	Amer.	S.D.	14 9	S	88	80	5 4	20	31	80	6	D
59	Ital.	S.D.	10 6	S	71	64	7 5	26	59	140	5	E
60	Hung.	S.D.	18 2	S	63	64	7 9	20	54	118	5	B
61	Amer.	S.D.	16 6	P	72	71	7 3	25	45	212	6	C
62	Lith.	S.D.	15 3	S	100	104	9 3	10	46	217	5	E
63	Pol.	S.D.	15 4	P	81	76	7 5	22	55	341	5	D
64	Amer.	S.D.	16 8	S	96	91	6 3	18	35	102	5	C
65	Amer.	S.D.	14 1	S	96	90	6 3	17	50	207	8	D
66	Norw.	S.D.	17 9	P	93	88	5 7	15	10	528	6	C
67	Mix.	Dep.	15 7	S	90	75	7 5	22	55	336	10	C
68	Amer.	S.D.	16 7	S	84	74	6 1	28	45	280	5	C
69	Amer.	S.D.	14 8	S	102	83	6 4	26	37	304	7	C
70	Amer.	S.D.	16 2	S	68	70	7 0	20	54	190	0	E
71	Ital.	Incor.	15 10	P	84	83	8 1	27	46	146	7	C
72	Rus.	Theft	13 5	S	87	86	6 4	18	74	370	10	H
73	Ital.	Incor.	15 8	S	81	79	7 6	24	47	204	7	C
74	Ital.	S.D.	18 3	P		66	6 8	21	51	190	6	C
75	Amer. N.	S.D.	15 9	S	90	80	9 7	24	53	167	10	C
76	Ital.	S.D.	14 5	P	80	74	7 2	18	50	186	9	C
77	Amer.	Dep.	16 6	S	66	56	7 7	24	54	370	6	C
78	Rus.	S.D.	18 5	P	68	73	6 4	20	70	375	4	B
79	Amer.	S.D.	13 9	S	78	73	7 7	24	50	440	8	D
80	Amer.	S.D.	16 2	P	64	66	5 4	20	41	119	6	D
81	Irish	S.D.	16 8	S	78	77	5 5	32	48	112	4	D
82	Hung.	S.D.	15 11	S	70	72	6 5	24	50	356	5	A
83	Ital.	Theft	12 0	S	112	96	7 5	15	28	385	7	D
84	Amer.	S.D.	16 4	S	93	80	5 6	26	50	54	2	E
85	Rus.	S.D.	15 6	S	104	93	4 1	20	33	125	5	C
86	Amer.	S.D.	18 1	S	81	85	6 5	20	63	36	6	A
87	Pol.	Incor.	16.1	S	93	94	7 7	21	50	325	3	C
88	Amer. N.	S.D.	16 10	S	72	67	6 3	21	41	151	6	C
89	Amer. N.	S.D.	16 1	S	77	80	7 6	21	36	170	0	D
90	Amer.	Theft	15 11	P	83	84	6 6	29	43	148	0	E
91	Amer.	S.D.	16 3	S	92	88	4 8	14	21	17	0	C
92	Pol.	S.D.	16 0	S	70	90	8 3	22	38	207	7	D
93	Amer.	S.D.	13 0	S	100	106	5 1	74	34	215	6	C
94	Ital.	Theft	15 0	P	83	76	6 2	22	23	111	6	D
95	Lith.	S.D.	15-12	S	86	79	9 1	22	35	195	0	C
96	Mix.	S.D.	17.2	S	88	97	5 0	26	41	14	7	C

APPENDIX B—*Continued*

Case No.	Nationality	Committed For—	Age (Years and Months)	Classification	E.Q.	I.Q.	Thurstone Score	F Score	P-S Score	X-O Score	Suggestion	Mark
97	Amer. N.	S.D.	13 11	S	87	70	5.0	30	73	270	6	E
98	Amer.	S.D.	15 6	S	103	107	3.7	21	27	39	6	C
99	Irish	S.D.	17 3	P	75	71	6.3	33	70	118	6	D
100	Amer. N.	S.D.	15 4	S	87	76	9.0	22	72	224	5	A
101	Amer. N.	S.D.	13 1	S	97	88	5.7	10	61	448	5	C
102	Pol.	S.D.	15 2	S	76	69	7.4	22	63	301	10	A
103	Pol.	Theft	13 4	S	90	81	7.1	19	43	114	8	C
104	Hung.	S.D.	17 7	P	87	95	4.0	20	55	136	10	C
105	Lith.	S.D.	16 7	S	75	70	5.6	35	66	138	4	E
106	Eng.	S.D.	16 6	S	86	83	7.0	17	34	170	10	D
107	Amer. N.	S.D.	17 2	S	75	79	5.8	20	18	111	6	C
108	Amer.	S.D.	13 5	S	75	74	6.4	19	30	96	6	E
109	Amer.	S.D.	15 8	S	98	96	6.1	39	76	313	4	E
110	Amer. N.	Incor.	17 3	S	85	92	8.1	28	51	83	5	A
111	Amer.	S.D.	15 9	P	80	76	3.6	12	81	137	6	E
112	Mix.	S.D.	18 3	P	76	86	6.5	11	43	109	5	C

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